THE ELECTRICAL EXPERIMENTER

August 1914

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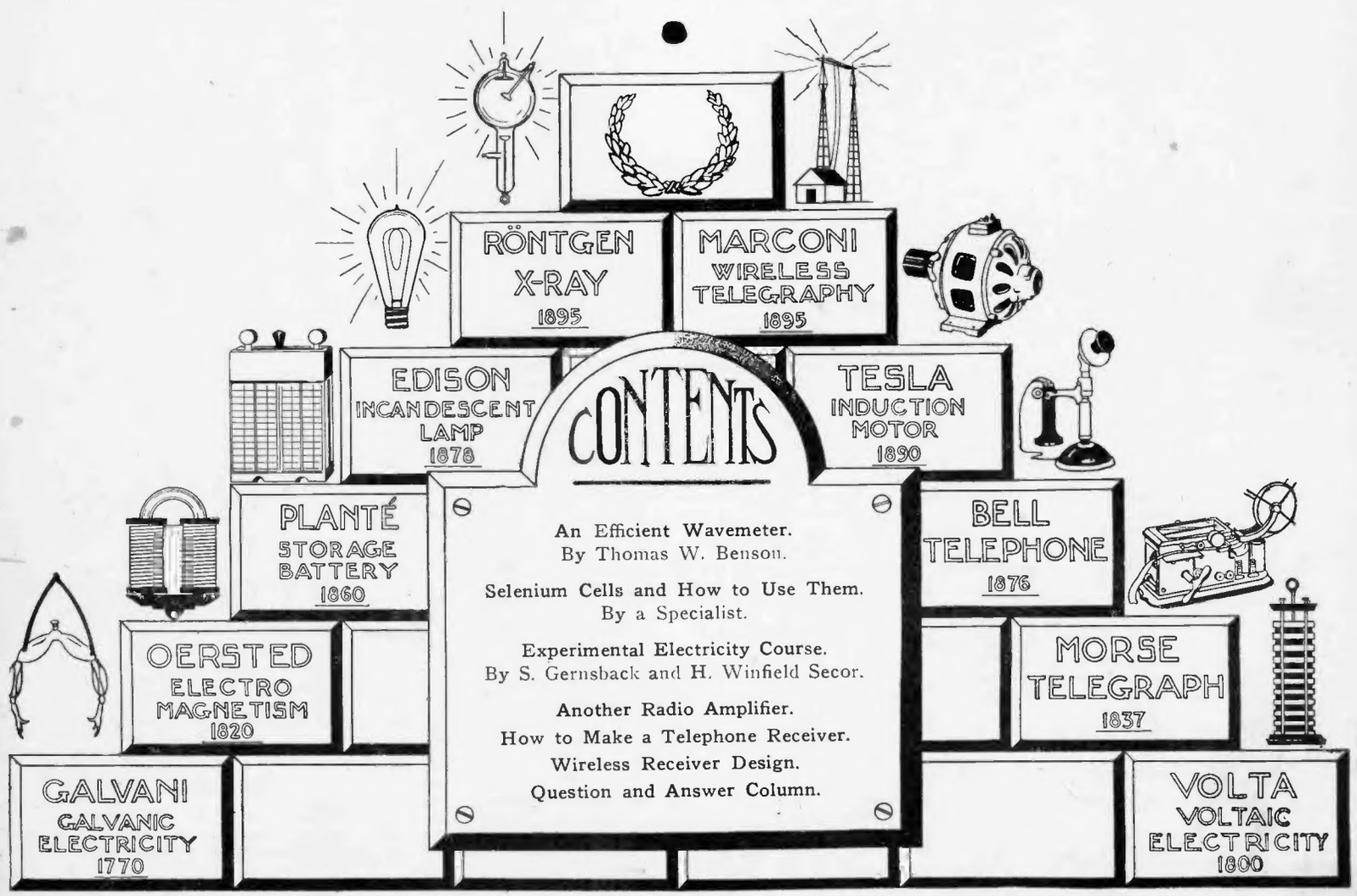

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THE ELECTRICAL EXPERIMENTER

VOL. II AUGUST, 1914 NUMBER 4

An Efficient Wavemeter

By Thomas W. Benson

EVERY now and then a notice appears in magazines to the effect that some amateur has been reprimanded or fined for breaking the present wireless law. Most of these offenses are involuntary, as the average amateur has no means of measuring his wave length; and, of course, when his wave is over 200 meters he doesn't know it till he gets called down by some government or commercial radio station.

The only sure method of measuring your wave is by means of the so-called wavemeters. These are usually rather

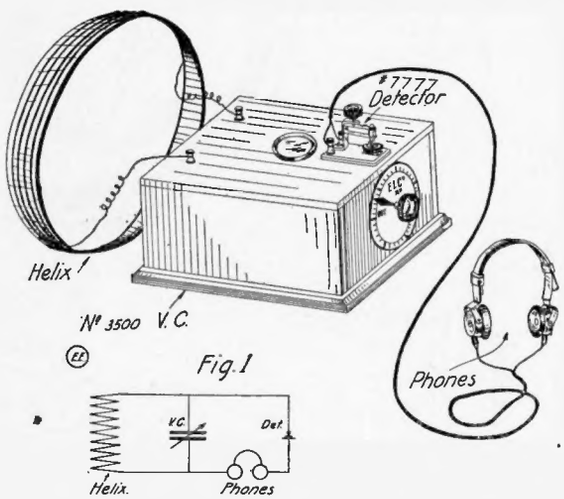


Fig. 1

costly, and this description on how to make one will help the amateur to keep within the law.

A wavemeter consists of an inductance shunted by a variable capacity and some method of determining when resonance is reached, generally a detector and phones.

For the variable capacity a Gernsback rotary variable condenser is ideal (or the slide plate type may be used), and due to its high capacity, a long range of wave lengths may be measured. For the inductance wrap 4½ turns No. 16 D. C. C. Wire on a cardboard ring 6 inches outside diameter, and ¾ inches wide. Run the two ends through holes and leave about 6 inches of each end loose inside. The whole coil should be then taped, thoroughly shellacked and allowed to dry.

The detector may be any one of the several manufactured by the Electro Importing Co., but their Universal Detector Stand No. 7777 used with carborundum will give good results.

For phones any set with a resistance of 1,000 ohms may be used; you can take the pair off your regular set and use them. Mount two hard rubber binding posts No. 1920 on the front edge of the condenser, the detector immediately behind them, and the coil is to be connected to the binding posts of the condenser by means of the two 6-inch ends. These will be found strong enough to support the coil. In the figure is given the hook-up to use it, and a perspective view of the finished apparatus also. If you wrap these carefully and send it to the Bureau of Standards, Washington, D. C., I believe they will calibrate it for you at a nominal charge. Otherwise you will have to have a friend who owns a meter calibrated, or as a last recourse, plot the resonance curve by direct calculation.

To do this, determine the amount of inductance by the common formula:*

$$L \text{ in centimeters} = \frac{(5 \times D \times T)^2}{M + 1/3\,D}$$; where D is the diameter of the coil; T, the number of turns and M, the length of the winding. This latter should be ¼ inch. This will give you 8,100 centimeters. As the condenser has a maximum capacity of .01 M. F. we can find the maximum wave we can tune for, from the following formula.

Wave length in meters $= 59.6 \sqrt{L \times C}$; or

Wave length $= 59.6 \sqrt{8100 \times .01}$ and thus

Wave length = 536.4 meters or 530 in round numbers.

By using this formula, and substituting the capacity for the different degrees of the condenser scale, we can plot the curve. Obtain a piece of cross sectioned paper, and number the squares like our sketch.

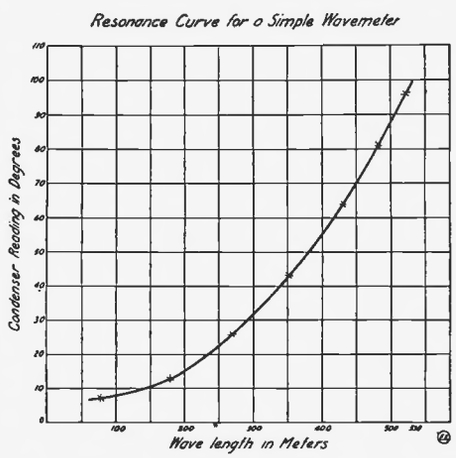
To find wave length with condenser reading 50°; use .5 of .01 M. F. or .005 in the formula; this on solving gives 379 meters.

Take the proper value of capacity for every ten degrees on the scale, and calculate them, and make a list similar to the one below:

Scale reading of Condenser Degrees	Wave Length in meters Meters	Scale reading of Condenser Degrees	Wave Length in meters Meters
100	530	50	379
90	509	40	339
80	479	30	287
70	448	20	239
60	415	10	149

Place dots or crosses on the paper for each reading, and connect them all to form a smooth curve so intermediate readings may be taken.

Nothing further need be said of the method of using the meter, as descriptions of the various uses it can be put to have appeared many times before, notably in the January, 1914, Electrical Experimenter.



See the Inductance formulae given in E. I. Co., Wireless Course Lesson No. 19, preferably, and also U. S. Bureau of Standards publications, giving complete and exact formulae, with tables, which can be obtained for a few cents from the Supt. of Documents, Wash., D. C.

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If you change your address, notify us promptly, in order that copies are not miscarried or lost.

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SELENIUM CELLS AND HOW TO USE THEM.

By A Selenium Specialist.

THE well known property of selenium which causes it electrical resistance to vary in proportion to the amount of light thrown upon it, when the selenium has been properly fused and carefully annealed for several hours, causes this wonderful metal to become of rare service to electricians for many different purposes. The perfected "Electro" selenium cells are of the type illustrated at fig. 1, and a small glass window about ½ inch in diameter is placed in front of the selenium grid, and light is admitted to the cell thru this window.

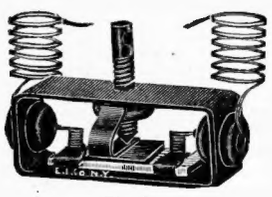

Fig. 1

Two wire terminals are provided on this cell so that it is readily connected in any circuit desired. The usual and commonest method of using a selenium cell, is to cause a bell to ring whenever light, such as daylight or electric light from an ordinary 16 or 32 C. P. lamp is thrown on the cell's window. The more direct and concentrated the rays of light, the more pronounced and rapid is the action of cell. A good way in which to mount the cell for laboratory or demonstration work is seen at fig. 2. Here the cell is placed in a block of 1" wood, provided with a folding cover, which may act as a shutter to admit or cut off the light.

The common hook-up for the selenium cell, together with a battery of 6 to 9 dry cells and a sensitive relay, preferably one having 100 ohms to 500 ohms resistance, and of the Polarized type, as supplied at reasonable prices by the E. I. Co. is shown at fig. 3. A couple of dry cells and a common vibrating bell serve as the indicator, or any apparatus whatever may be connected to the relay of course, such as whistle, miniature gun for demonstrations, etc.

The resistance of these selenium cells vary quite widely, and a common range is from 1,000 ohms in the light to 2,000 or 3,000 ohms in the dark; also cells having ranges such as from 5,000 ohms in the light to 25,000 ohms in the dark are common. In other words, the light and dark ratios vary for different specimens at anywhere from 2 to 1 up to as high as 5 to 1 etc. It is impossible to make these cells with predetermined resistances or any light and dark ratios desired, and so a lot of them are made up, and then they are tested on a Wheatstone bridge, for light and dark resistances; and from these values of course the light to dark ratio for a certain cell is readily computed. Some cells run much higher than those cited above, but a ratio of light to dark resistance of 7 or 8 to 1, is about the best ordinarily obtainable. A very high resistance and sensitive relay should preferably be used with a very high resistance cell. Also more batteries are necessary with extra high resistance cells.

Fig. 2

Where the ratio between light and dark resistance is not sufficient for the requirements at hand, or for special work, etc., this ratio may be greatly increased, even to as high a value as 50 or 80 to 1; even tho the cell proper, has only an inherent ratio value of 2 to 1; by arranging the cell in a divided bridge circuit like that shown at fig. 4 (first used by Dr. Korn, in his telephotography). Here the resistance, RS, in the form of a coil (or better of non-inductive carbon rods as supplied by the E. I. Co.), is placed in one arm of the bridge circuit, and its resistance should be the same as the cell's value in the dark. The relay or other apparata is connected as indicated, and under these specified conditions, both batteries should be made up of the same number and kind of cells, and if they are all regular type dry cells, large or flashlight size, they will do alright. If by chance such high resistances as needed are not available, then a lower or higher resistance at RS, can be employed, so long as the following equation is balanced by changing the dry cells in each set to suit.

The equation used is as follows:

$$\frac{E\ 1}{E\ 2} = \frac{R.S.}{r}$$

So if for instance, the resistance unit R S, had a value, say of 5 times the cell's dark resistance r, then if 5 dry cells are used in the selenium cell side of the bridge; only 1 dry cell would be necessary in the R. S. unit side of the bridge, or for battery B 2 (giving voltage E2).

To find the maximum cell voltage for any particular specimen, the cell may be heated carefully in an air bath to about 100° Centigrade (220° Fahr.), and note carefully in what manner the conductivity changes, with the temperature, by taking suitable Wheatstone bridge measurements, etc. The maximum cell voltage for any particular specimen, should be considered the one that produces the same change in conductivity as 50-80° C. heating (when in steady state). In other words, the current which heats the selenium to about 70° C. is the maximum current which should ever be used.

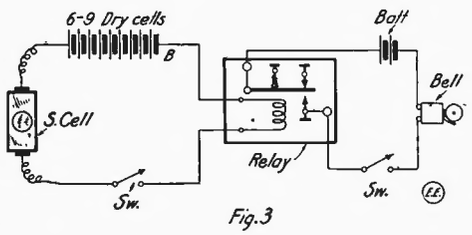

Fig. 3

Selenium cells are sensitive to light in proportion to the strength of the light beam striking them, and this enables them to be used for speaking arcs, as described in the July Electrical Experimenter, and for a number of other purposes, including talking motion pictures. Also these cells do not act instantaneously, but require a small fraction of a second in which to act. The stronger the light the quicker their action, and vice versa. The above data is supplied by one of the foremost selenium specialists of the day, and the "Electro" cells described and illustrated are the same type as used by all the leading inventors, including Dr. Korn, of Germany; John Hays Hammond, Jr., the American investigator of radio controlling devices; Mr. Riess, E.E., research engineer, N. Y. City, etc., etc.

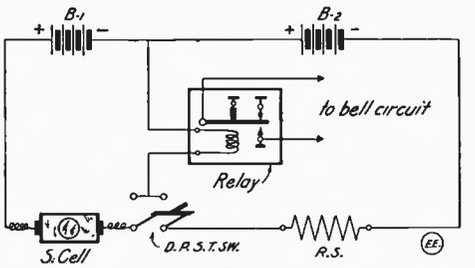

Fig. 4

THE HORSEPOWER OF A RAINSTORM

Recently, there was a severe rainstorm in this locality, says G. P. Pearse, in a recent issue of "Power," and when talking to an engineer about it afterward, the question of its horsepower arose. I was interested enough to hunt up data on which to base a calculation.

The rainfall amounted to 4.17 in. in 10 hr. over a surface of approximately 10 square miles, and the estimated average height of the rain cloud was 5000 ft. This represents approximately 6,000,000,000 lbs. of water which had fallen during 10 hr. from an elevation of 5000 ft., or 15,000,000 hp.-hr. Thus we see the energy represented by this one short storm.

Suppose man could avail himself of this energy and store it so it could be used at pleasure; for instance, for lighting city streets with 4000 arc lamps. Allow 500 watts per lamp, making 2000-kw. load during the lighting period equal to 2680 hp. or, including losses, say, 3000 hp. Allowing 12 hr. in 24 as the lighting period, the daily load will amount to 36,000 hp.-hr.

The length of time this energy would last would be 425 days, or one year and two months of light from one storm. This gives some idea of the enormous energy at work in nature.

EDISON'S TABLE VIA WIRELESS.

Thomas A. Edison's favorite pursuit is chemistry. Even as a boy operator getting his first start toward a career, this inclination was manifest in his experiments with batteries and electric devices, and it still remains his greatest pleasure.

His laboratory is splendidly equipped. Every known substance ranging through all the kingdoms of matter from lanthanum to shark's teeth and including over 200,000 specimens, is kept on hand for immediate availability. It is a collection of over 30 years' standing, encouraged from time to time by prizes for new additions offered by the inventor to his men.

His own laboratory table is never under any circumstances allowed to be touched. A notice posted on the doorway reads to the effect that Mr. Edison is not to be disturbed in the course of his experiments except for matters of the utmost importance. So fond is he of his beloved pastime that he declares his idea of heaven is to be able to continue it, and his injunction to his staff are: "When I die I want my table forwarded to me intact via wireless."

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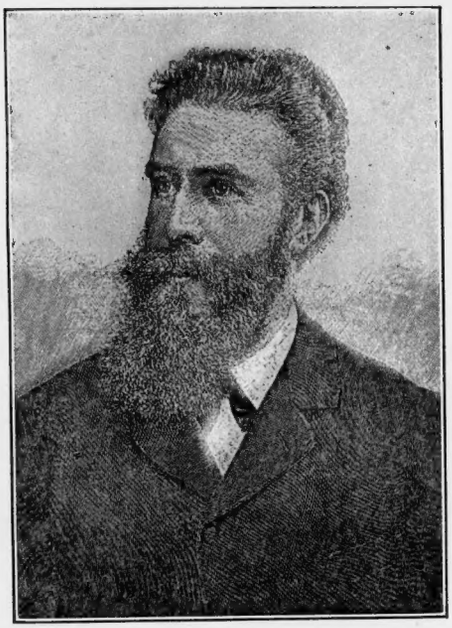
Experimental Electricity Course

By S. Gernsback and H. Winfield Secor

LESSON 13.

THE X-RAY.

THE so-called X-Rays or Roentgen Rays, were discovered by Professor Roentgen, of Wurzburg, Germany, in 1895. He was at that time experimenting with electrical discharges in evacuated Crooke's tubes, exhausted to one one-millionth of an atmosphere. X-Rays are the result of an electrical discharge setting up or creating waves in the ether, the same as in wireless telegraphy, with the difference that these waves have a very minute length, and extremely high frequency; as a contrast to wireless waves which are of fairly long length and low frequency.



PROF. ROENTGEN

In consequence of the short wave length of the X-Rays, they are capable of passing through a great number of solid substances, nearly as readily as light waves pass thru glass.

Solid substances including metals, absorb the X-Rays, in proportion to their density generally. Lead and iron are almost opaque. Aluminum offers but slight resistance to the rays. Diamonds are nearly transparent. Glass and quartz absorb a greater portion of the rays. The bones of the human body are fairly opaque, while the vital organs and muscles are not so opaque. The lungs are nearly transparent.

The following data on the relative transparency of various substances to the X-Rays may be of interest to the reader.*

TRANSPARENCY OF VARIOUS SUBSTANCES TO X-RAYS.

(Batelli and Garbasso.)

Material.	Specific Gravity. Water = 1.	Transparency. Water = 1.
Pinewood	0.56	2.21
Walnut	0.66	1.50
Paraffin	0.874	1.12
Rubber	0.93	1.10
Wax	0.97	1.10
Cardboard	—	0.80
Ebonite	1.14	0.80
Wool-cloth	—	0.76
Celluloid	—	0.76
Silk	—	0.74
Cotton	—	0.70
Bone	1.9	0.56
Coke	—	0.48
Glue	—	0.48
Sulphur	1.98	0.47
Aluminum	2.67	0.38
Glass	2.60	0.34
Tin	7.28	0.118
Zinc	7.20	0.116
Iron	7.87	0.101
Nickel	8.67	0.095
Brass	8.70	0.093
Cadmium	8.69	0.090
Copper	8.96	0.084
Bismuth	9.82	0.075
Silver	10.5	0.070
Lead	11.38	0.055
Mercury	13.59	0.044
Gold	19.36	0.030
Platinum	22.07	0.020
Liquids.		
Ether	0.713	1.37
Petroleum	0.836	1.28
Alcohol	0.793	1.22
Olive Oil	0.915	1.12
Water	1.00	1.00
Glycerine	1.260	0.76
Nitric Acid	1.420	0.70
Chloroform	1.525	0.60
Sulphuric Acid	1.841	0.50

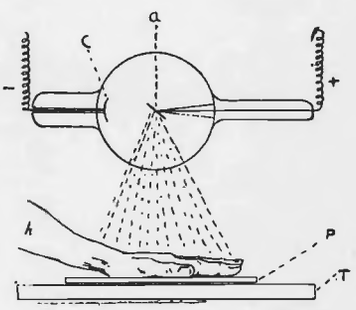
*See "Standard Handbook for Electrical Engineers."

The X-Rays as emitted from a tube made for the purpose, are invisible to the eye. They are easily rendered visible, however, by observing them thru a cardboard screen, coated with a fluorescent substance such as, Barium-Platinum-Cyanide, Calcium Tungstate, Willemite, etc. These screens become luminous in proportion to the strength of the X-Rays falling upon them. The manner of observing an X-Ray view of the hand is shown at fig. 1, and as seen, the hand is placed a short distance away from the tube, and between it and the fluorescent screen. The screen is usually fitted with plush, fur, etc., at the smaller opening, and cut to fit the face about the eyes.

Fig. 1.

The picture of the hand thrown on the screen, will show the bones and flesh distinctly, owing to the much greater absorbing quality of the bones as compared to the flesh. The bones appear as a dark shadow, the thicker the bones, the denser the shadow. Actually the bones are not seen through a "fluroscope," but what is seen is a shadow picture produced by the conversion of the X-Rays into light by the fluorescent chemical on the screen.

In fig. 2, is shown the method of taking a "skiagraph" or X-Ray photograph. The tube is excited by a spark coil or static machine. At a is the positive electrode or anode; C is the negative electrode or cathode; h the hand of the patient; P the photographic sensitive plate wrapped in an opaque envelope or enclosed in a plate holder with the slide in; and T, the table. The duration of the exposure to the X-Rays will depend upon the strength of the exciting apparatus and tube, and also upon the thickness of the tissue and bone through which they have to pass.



METHOD OF TAKING A SKIAGRAPH

Fig. 2

With large professional machines, such as used in hospitals, it varies from a few seconds to ½ minute and more, according to whether the "skiagraph" is of the hand, the foot, the head, the pelvis, etc. The pelvis is one of the hardest parts of the human body to skiagraph, as it is so thick.

Many ingenious ideas are utilized to obtain skiagraphs of various parts or organs of the body. As an example, before taking one of the stomach, the patient is fed a bismuth meal, consisting of specially prepared bismuth tablets. The density and transparency of bismuth is many times higher than that of the flesh or muscles, hence a difference in the shadows cast upon the screen, enable the stomach outline to be discerned from that of the bones and flesh.*

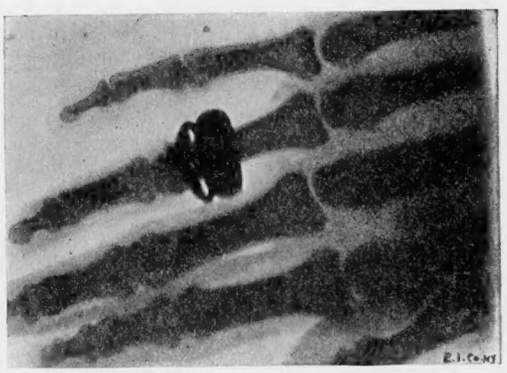


Fig. 3

*See Dr. Strong's "Modern Electro-Therapeutics."

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A very good skiagraph of the hand of a lady, with wedding and diamond rings on the finger, is illustrated at fig. 3. This X-Ray photograph was taken as previously explained, the length of exposure being 10 minutes, distance of tube from hand, 5 inches, photograph plate 8 by 10 inches. The exciter for the tube consisted of a 1½ inch "Electro" spark coil, with

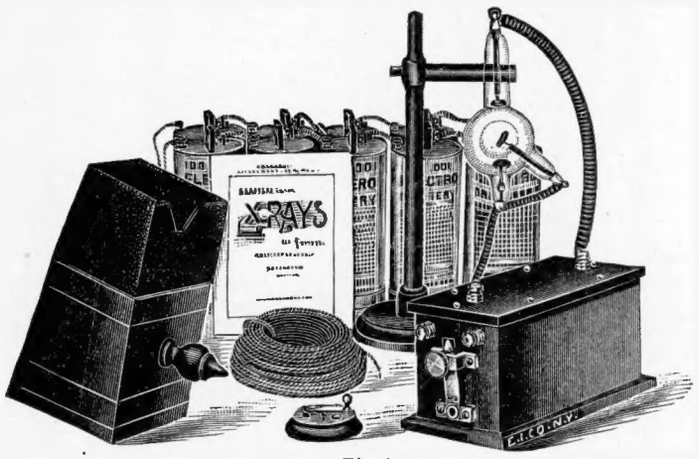


Fig. 4

French double spring vibrator, and a 6 volt dynamo exciting the primary circuit of the coil with 5 volts and 2 amperes. The tube was a standard tube designed to be operated on from 1 to 3 inch spark coils. In general, the 1½ or 2 inch coil gives the most satisfactory results, and the larger the coil and tube, the quicker the skiagraph can be taken. For surgeons' use a 10 to 12 inch spark coil with electrolytic or

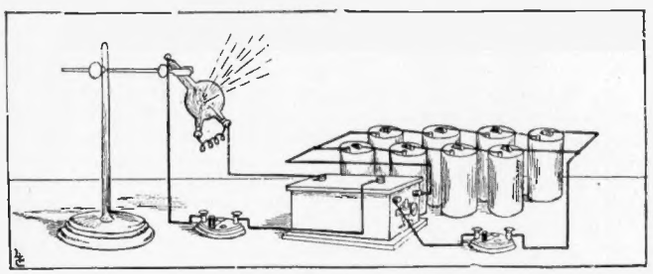


Fig. 5

mercury turbine interrupter is generally employed. Some hospitals and private practitioners make use of as large as 20 inch spark coils, or special transformer sets, utilizing a 120,000 volt high tension transformer, operating from the alternating current circuit.

An X-Ray outfit complete, and comprising a special 1½ inch spark coil, X-Ray tube, fluroscope, wire, switch, batteries, and treatise on X-Rays, is depicted in fig. 4. This enables anyone to experiment with the wonderful X-Rays, and the price is very low, being but $17.75 for the whole outfit ready to set up. The wiring diagram for this set is shown at fig. 5. The X-Ray tube is connected across the secondary circuit of the spark coil. To prevent puncturing the tube and as an aid to the regulation of it, a safety spark gap is invariably left connected across the secondary terminals of the coil, the length of the gap being a little less than the spark length rating of the coil.

Fig. 6

The tube used in this outfit is shown at fig. 6. It is an imported tube, and is self regulating as regards the vacuum.

In the drawing fig. 7, is outlined the action of the focus X-Ray tube. The cathode or negative electrode is at K, and is of aluminum, concaved so as to direct the torrent of radiant matter to a concentrated focal point on the anode or anti-cathode A. At this point of impact on the molecular target, the X-Rays are abundantly generated, and as the target is of platinum, it is not only enabled to withstand almost any heat developed, but it also allows no penetration of the X-Rays to its reverse face.

The X-Rays which are generated at the point of impact on A proceed radially outwards in straight lines in all directions, and as A is placed at an angle of 45 degrees, with the axis of the tube, the X-Rays pass out thru the glass, opposite to the centre of the plate, without encountering any considerable opposition. In fig. 7, the direction of the cathode stream toward the concentrating point on the anode A, is represented by the dotted lines. The direction of the radiation of X-Rays are represented by dot and dash lines and extend thru the cathode K, but are not drawn in to make the cut clearer.

As the X-Rays pass out thru the glass wall of the tube, they produce fluorescence, usually of a canary yellow or apple-green color, but this varies with the chemical structure of the glass and the degree of exhaustion. It is often bright, and occurs exactly over the area which is exposed to the Roentgen rays. The results obtained with the focus tube are what one would expect, when the source of the rays is almost a point, i. e. radiographic and screen effects are thereby rendered much sharper and more detailed, without the necessity of working with the tube at some distance from the plate.

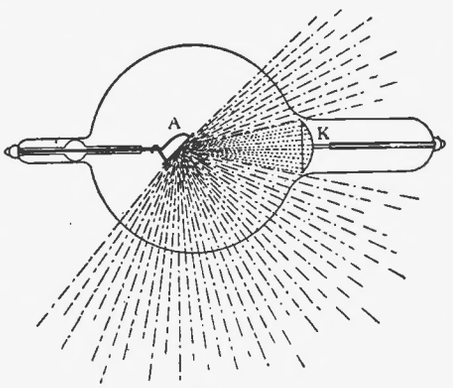


Fig. 7

A special water-cooled anode tube is seen at fig. 8. The anode electrode tends to heat up and the water cools it to some extent.

In the X-Ray tube of standard pattern, the predominant feature governing its behavior under given circumstances is the resistance offered by it to the passage of the discharge.

If the resistance be too high the rays which are produced have great penetrative power, and pass thru bones almost as easily as through flesh, producing *skiagraphs* of flat quality, and wanting in contrast. A tube of too low a resistance produces X-Rays which have little penetrative power, are almost stopped by the flesh, and entirely so by the bones, which appear dead black with no structural detail visible.

There is a wide range for choice between these limits, and in regular practice, a different degree of exhaustion is employed for certain classes of work.

A low resistance tube of small penetrating power is called *low,* or more usually *soft;* and one of high resistance with great penetrating qualities is known as *high* or *hard.* The resistance tho principally governed by the bulb is also affected by the dimensions of the cathode and its distance from the anode.

The cathode, K, in fig. 7, is invariably cup-shaped, and is made of such curvature that the rays emanating from its surface converge with a certain degree of accuracy upon a point in the centre of the anti-cathode or anode electrode surface A.

A high resistance results from the use of a small cathode, and penetrative rays. A large cathode gives a low resistance and soft results. For ordinary work a cathode diameter of one inch is quite suitable.

Aluminum cathodes are much in vogue, because the discharge would disintegrate particles from any other metal, and distribute them all over the inner surface of the bulb, and blackening it thereby. The surface of the electrode should be uniformly curved, and very highly polished.

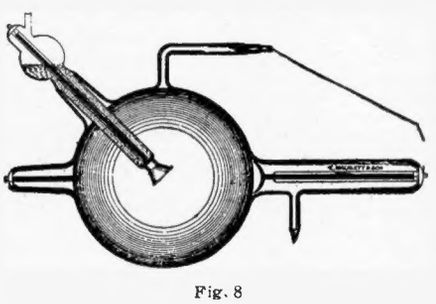


Fig. 8

The greater the accuracy employed in making and mounting the electrodes in the bulb, the more finely the cathode stream (see fig. 7), can be focused upon a fine point on the anode, and the more sharp and detailed will be the skiagraphs obtained.

This is due to the fact that the source of the Roentgen rays is this point of impact, and from it they proceed in straight radial lines.

Owing to the violent bombardment of the anode surface by the cathode stream, it tends to get extremely hot, especially if the bombardment is centered exactly at one small point, and a hole would soon be burned thru it.

In practice, however, the concentration is never accurate in ordinary tubes, a compromise being made between the sharpness of focus, and the heating effect. From this it is evident, that anything which enables the anode to lose its heat rapidly, or to stand a high temperature without being damaged, also allows of a more accurate concentration of

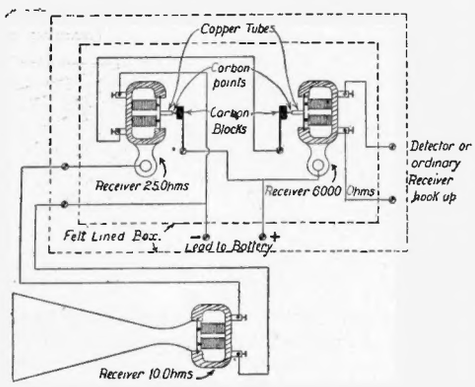
(To be continued)

THE CONSTRUCTOR

ANOTHER AMPLIFIER FOR WIRELESS SIGNALS.

I have just completed an arrangement for making wireless signals audible at a much greater distance than usual, without the use of head 'phones, and a description of this might, I think, be of interest to your readers, says L. W. Pullman, in *Model Engineer and Electrician.* It may not be new, although I have never seen the idea in any of the wireless papers that I read.

I think the sketch speaks almost for itself. The springs that support the carbon blocks indicated in sketch are of thin copper 3/10 mm. thick and 1 mm. wide. The carbon points against which they rest are made from the lead of an HH pencil. The three telephones are as follows: Firstly, 6,000 ohms; secondly, 25 ohms.; and thirdly, about 10 ohms. Up to the present I find that this combination gives me the best results. The weight of the carbon blocks does not seem to be of very great importance, say about 10 grams.



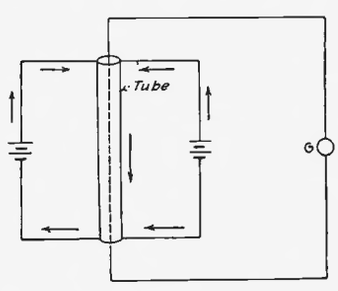
These latter are soldered on to the copper springs; this is easily done by depositing electrically a thin coat of copper on them or pieces of ordinary carbon motor brushes may be used, which are copper plated. The whole is operated by a 2-volt accumulator or storage cell, and the microphones use so little that even when they have been left in circuit for four days and nights without interruption, the drop in voltage is almost imperceptible. The only difficulty in the construction of this instrument is soldering the small copper tubes on to the diaphragms of the receivers which carry the pencil points. For this "Solderall" may be used. It must be quite clearly understood that once the diaphragm is heated it loses its shape and is useless, so that the *tube only* must be heated with a small blowlamp. I intend to continue my experiments in this sort of loud speaking 'phone, and if any of your readers can help me or I can help them, I shall be most happy, says Mr. Pullman, and we certainly *shall* be pleased to have similar articles submitted to the "Electrical Experimenter" covering improvements on this class of exceedingly interesting apparatus.

Although the apparatus is not yet regulated as it should be, I get KAV and FL musicals quite clearly. Of course, the musicals are very much more difficult to regulate for than the rarefied spark that FL uses for the time signal and weather report, which, with this arrangement, can be heard all over the house.

Since writing the above, I have tried a magnetic relay of 250 ohms in the place of the 10-ohm receiver, and find that I have sufficient force to work a Morse tape writer with FL rarefied spark.

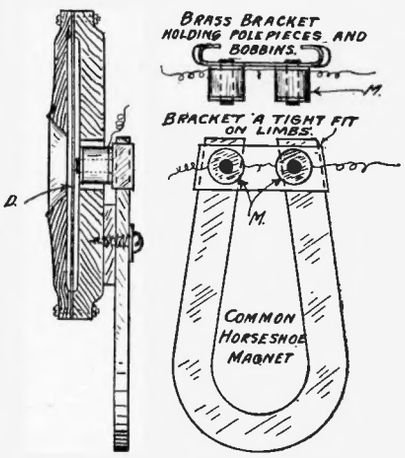
AN ELECTROMAGNETIC PUZZLE.

A conducting tube forms the return circuit as shown for two sources of E. M. F., making a symmetrical arrangement of conductors with the tube as the central common path. The magnetic flux in such a tube is everywhere zero, and yet if the tube be threaded with a wire having its ends connected to a galvanometer and the flow of current be interrupted or restored in the tube, an induced E. M. F. will be indicated by the galvanometer, according to Prof. F. J. Rogers, of Princeton University, who submitted this phenomenon to the American Physical Society, at its Washington meeting, as "an electromagnetic puzzle." From his own experiments Professor Rogers reports that he found the induced E. M. F. to be proportional to the length of the conductor tube inclosing the galvanometer circuit.—*Electrical World.*



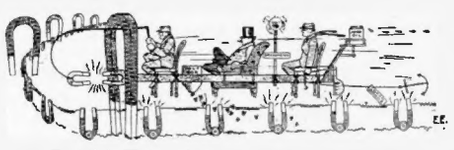
HOW TO MAKE A TELEPHONE RECEIVER.

A simple and very efficient telephone receiver can be readily made from an "Electro" permanent steel horseshoe magnet, as shown in our drawing. About a 4 to 5" magnet makes a very strong and sensitive telephone receiver and a couple of them may be used clamped together, to give greater magnet strength if desired. A piece of brass is bent as shown in the sketch, and on this brass clamp or bracket, are secured two small round soft iron cores ¼" diameter wound with two small spools of No. 34 insulated magnet wire or thereabouts; to give a joint resistance for the two spools in series of 75 to 100 ohms. These magnet spools may be about 7/16" inside length along the core, between the fibre or wood end cheeks on same; and they should be wound about 5/16" deep with No. 34 insulated wire; and enameled magnet wire is very good for the purpose, such as supplied by the E. I. Co. The diaphragm "D" as usual, is mounted in front of the poles of the electro-magnets as shown, and it is rigidly secured between two wood or fibre caps which are clamped together by 3 or 4 small machine screws and nuts, in the manner indicated. About 1/16 of an inch air space should be left on either side of the diaphragm, and the sound chamber is secured to the permanent steel magnet by a cross-bar and wood screw as illustrated. The diaphragm should not be much over 2" to 2¼" in diameter, at least in so far as the diameter that is free to vibrate, is concerned. This receiver is very easily hung up when not in use, by the electro-magnet yoke, as becomes apparent; and the telephone receiver thus made is serviceable for regular telephone requirements or wireless purposes, etc.



Also this telephone receiver can be very nicely made up for experimental and other work by employing one or more permanent steel magnets as previously mentioned; and for the electro-magnets a pair of E. I. Co. electro-magnet windings No. 01108 having 50 ohms in each winding, can be used or if the receiver is to be used for wireless purposes, 150 ohms joint resistance can be obtained by using two of the No. 01109 electro-magnet windings, which have a value of 75 ohms each. The 50 ohms magnets are worth 20 cents a piece, and the 75 ohm magnet windings 30 cents a piece.

(*Contributed by Chas. Rosenthal.*)



Rapid Transit, "A La Bachelet."
(*From the London "Electrician."*)

A SINGLE CORD ADJUSTER.

One is not always able easily to regulate the height at which a portable electric lamp shall hang. Here, however, is a simple device that removes that difficulty. It consists of any bit of spiral spring. The cord that contains the wires of the lamp can be inserted between the coils of the spring and adjusted at any desired height. The coils must be tight or the lamp will slip down of its own weight.

TELEPHONES AS ALARM CLOCKS

In London a man who wants to be awakened at a certain time can call up central on the telephone and leave his number and the hour. At the precise moment his telephone bell will ring, and it will keep on ringing until he answers. The charge for such a call is six cents.

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THE MAKING OF SELENIUM CELLS.

Below is given the method of procedure for making the Bidwell and Ruhmer type of selenium cells utilizing the selenium, etc., as furnished by the E. I. Co.

Take a piece of mica 2¼ inches long and ¾ inch broad and beginning at ¼ inch from one end, wind round it in the form of a flat spiral some No. 40 copper wire. The pitch of each turn of the spiral is 1/16 inch from its neighbor. Continue winding up to ¼ inch from the outer extremity, then fix the two ends of the wire, by passing them thru holes drilled in the mica. Now take a second wire and carefully wind this on beside the other, thus forming a second spiral, the turns of which are midway between those of the original one. Fix this as before (Fig. 1). Great care must be exercised that the two wires do not touch each other at any point. It will be well to make sure by testing this with a telephone receiver.

For the succeeding operation a retort stand at least 15 inches high is convenient. Fix the ring 15 inches above the base; on the pedestal place a Bunsen burner (E. I. Co. No. 1352). On this ring (Fig. 2) lay a flat sheet of brass 1/16 inch thick, and on the brass a piece of mica (to save waste selenium). Place the embryo cell on the mica plate, having brought the Bunsen burner close under the brass, melt a few grains of stick selenium (E. I. Co. No. 9211) in a small spoon and let four or five drops fall upon different parts of the cell. Spread the melted selenium evenly over the surface with a piece of mica, a steel knife or spatula, and at the same time pressing it well between the wires.

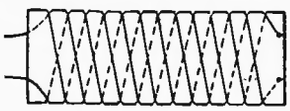

Fig. 1

During this process the temperature must be carefully regulated by raising or lowering the temperature of the Bunsen burner. If the temperature is not high enough the selenium will begin to crystallize; if too high, the selenium will collect in drops, being apparently repelled from the surface of the cell. The temperature should, in fact, be just above the fusing point of crystalline selenium. When a smooth surface is obtained, quickly remove the cell with a plier and let it cool. Its surface will now be smooth and lustrous.

The cell must next be annealed. The brass plate being cool, lay the cell upon it again, and adjust the burner at its lowest possible point. The selenium will soon begin to crystallize, as evidenced by its surface assuming a dull leaden appearance. (If crystallization has not begun in five minutes, raise the burner an inch or two.) In from five to ten minutes the whole of the selenium should be crystallized. Then gradually raise the burner until signs of fusion just begin to appear. This will probably take place when the flame is within three inches of the brass. Instantly remove the burner, and in about ten seconds re-crystallization will occur. Now fix the burner ½ inch below the point at which it was when fusion commenced, and let it remain for four hours, merely looking at it from time to time to ascertain that, owing to increase of gas pressure or other causes, the heat has not become too great. After four hours, begin cooling by lowering the burner an inch or two, and repeat this operation every ten or fifteen minutes, until the burner is at is lowest point. Then slightly lower the gas flame at short intervals, until it is finally extinguished. When the brass plate is quite cool, the cell may be removed.

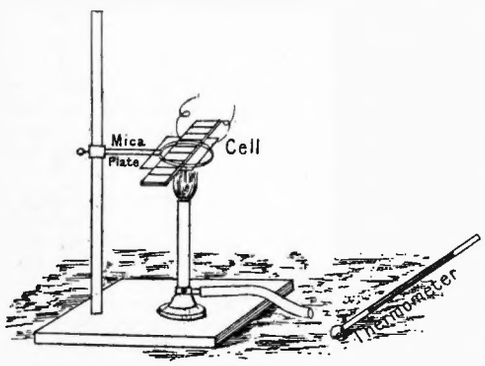

Fig. 2

A cell made in this manner is found to have a resistance in the dark of from 50,000 to 100,000 ohms.

It is an old established fact that cells of this type do not last long, as the resistance varies regardless of light, gradually with time. This is favored by the humidity of the atmosphere.

In order to make such a cell more permanent it is placed in a vacuum as in the Ruhmer type of cells.

This is made by winding spirally side by side two copper wires and spaced 1/32 of an inch apart on a porcelain tube (E. I. Co. No. 6277; any size can be used to suit the requirements of the experiment), the wires and the interstices between is filled up with the selenium and annealed, this is then mounted onto an incandescent lamp butt and the proper connections made thereto.

A test tube is then fitted over this and cemented onto the lamp butt and a vacuum is best produced in same.

The completed cell is shown in Fig. 3, while Fig. 1 depicts a Bidwell selenium cell.—*Reprinted from July, 1913, "Electrical Experimenter," article by S. Wein.*

Fig. 3

NAURU ISLAND RADIO STATION.

It is announced that the Pacific Island of Nauru has now an efficient wireless apparatus in operation, and messages are being sent to Yap, Caroline Islands, for transmission by cable to all parts of the world. Nauru island and Ocean island export large quantities of phosphate annually, and it is expected that Ocean island will also have a high power wireless installation before long. In the meantime, however, it is possible for vessels loaded at Ocean island to call at Nauru and report to their owners if desired.

Nauru island, or Pleasant island, as it is also called, is one of the Gilbert group.

GENERAL ELECTRIC CO. PERFECTS A PERFECT RADIO DETECTOR.

What is said to be the most sensitive wireless telegraph receiving instrument in the world has been perfected in the research laboratory of the General Electric Company. The instrument is now in use in the wireless station at the electrical laboratory of Union College.

Little can be learned concerning the instrument except that it has already been given trials that have, at least to the satisfaction of electrical engineers here, proved its superiority over any receiving instrument now in use.

TELEPHONE WIRES FOR AERIALS.

The demonstration of a new radio-telegraphic and telephonic receiver, invented by Lieut. Col. George O. Squier, Military Attache of the American Embassy, at London, Eng., created great interest at a recent meeting of the Royal Society.

The invention embodies the use of ordinary street telephone wires as antennae, requiring no mast.

Messages were received over long distances during the demonstration and were heard distinctly. The apparatus is cheap and can be adjusted to answer a number of messages simultaneously without interruption or interference.

DISCOVER ORES BY RADIO WAVES.

The Society for Investigating the Internal Structure of the Earth of Goettingen, Germany, declares it has succeeded in discovering by means of wireless telegraphy subterranean springs and ore deposits. It states that it also has ascertained their depth by the use of electrical waves applied according to the method invented by Prof. Leimbach of that city.

Prof. Leimbach on March 23, 1911, used wireless telegraphy for underground communication between the potash mines in the Northern Hartz mountains, when he sent messages a distance of nearly a mile and a half at a level of 1000 feet below the surface.

ALARM CLOCK GETS BREAKFAST.

A resident of California has rigged up an alarm clock so that it calls him at the proper time in the morning, lights a lamp in his bedroom so he can see to dress and at the same time starts breakfast cooking.

When the alarm clock sounds its early morning call, it throws a switch located at the back of the clock cabinet connecting four electric circuits. One of these circuits lights a small lamp which effectively illuminates the bedroom. To the other circuits are connected toaster, coffee percolator and electric grill. The coffee and water are put in the percolator the night before, the bread arranged in the toaster, and the bacon placed in the grill. By the time the owner is dressed breakfast is ready.

High speeds have been attained in transmission by wireless telegraph. A recent test resulted in sending 145 words a minute. The record for writing on a typewriter is 160 words a minute.

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WIRELESS DEPARTMENT

WIRELESS RECEIVERS.

AFTER the reading of Mr. Lucas's paper, (published in the June Electrical Experimenter), a discussion on the salient points raised was invited, in which the following gentlemen took part:

Mr. G. G. Blake mentioned the use of a soft-iron ring fastened on the underside of the telephone cover, above that side of the diaphragm remote from the magnet, so that its lines of force pass through the diaphragm and close up on this ring.

This arrangement, in some cases, Mr. Blake said, gave a distinct increase in the loudness of signals.

Mr. F. J. Chambers said that the solution of successfully designing a good receiver lies along the lines of practical experiments. The conditions which apply to ordinary telephone receivers and those used for wireless telegraphy are different. We have not to obtain a good speech producer in the latter case, nor are manufacturers obliged to produce a very cheap article, and there is, therefore, an opportunity for introducing refinements of contruction unknown in ordinary telephones. He suggested, in the case of a two-pole receiver, thickening the centre of the diaphragm, and so obtain a lower reluctance in that portion of the magnetic circuit. With reference to the supposed extreme sensibility of the diaphragm to high spark rate transmitters, this would be far more noticeable were the diaphragms influenced by a sinusoidal pull rather than the unidirectional impulsive effect, and have a high period, and, therefore, whilst some preference may be detected for certain high-pitched signals over others of the same order, all diaphragms should be equally sensitive to slow sparks like the Eiffel Tower, as the effect of one impulse is dead before the other succeeds. Owing to the fact that the turn to turn capacity in the receiver windings does no more than slightly augment the shunt capacity generally used in wireless, there is not the same disadvantage from using enamelled wire as there is in telephony, where this capacity would tend to reduce efficiency. With reference to "note tuning" he had been engaged for about a year in developing electrical methods for this purpose. He had used tuned circuits on the same lines as ordinary oscillation-receiving circuits, and had developed these methods to the stage of being able to select from three or four signals of the same intensity in one octave. The great point is that the circuits should not only have the right oscillation constant, but it was essential to so adjust the values that the circuits had very low damping co-efficients. The same applies to the diaphragm portion of the receiver. The undamped diaphragm was the ideal, and it seemed that the ideal diaphragm is identical with the selective diaphragm. Provided that the sparks in the transmitting station were regular, the undamped tuned diaghragm should afford a good means of securing additional selectivity.

Dr. Erskine-Murray pointed out that the problems involved in the designs of telephone receivers for articulate speech and for wireless telegraphy were essentially different. In the case of articulate speech, it was necessary that the diaphragm should be much damped, even if loss of energy was caused thereby, in order that it may follow the constantly changing wave form and pitch. In wireless receivers, on the contrary, the wave form is practically uniform for any given station, and in no case is the pitch above 1,000 per second. If the spark frequency is low the natural frequency of vibrations of the diaphragm does not matter, since each spark produces a shock excitation of the diaphragm, which then vibrates at its own frequency, but probably dies out before the next shock occurs. With high-spark frequencies a tunable telephone is advantageous, and it is clear that any damping which involves waste of energy is disadvantageous. In a further communication Dr. Erskine-Murray pointed out that the use of too powerful a magnetic field on the diaphragm tends to render the latter cup-shaped, thus reducing its elasticity and counteracting the magnetic advantage.

Mr. Russell Clark said that the importance of a strong field is very great, and that the problem is quite different to the problem of telephones for the transmission of speech. Articulation is unnecessary, and what is wanted is the greatest possible sound for a given current through the telephones. For wireless purposes experiments should be made on a powerful field obtained by electro-magnets, every precaution being taken to prevent eddy current and hysteresis loss. The magnetic pull varies as the square of the number of lines. If the permanent field is denoted by N, and the additional field produced by the arrival current is denoted by n, the pull is represented by $(N \times n)^2 + H^2 \times {}_2Nn \times n^2$. Neglecting n^2 the additional pull is represented by ${}_2Nn$, and therefore increases with the strength of the permanent field. In making an experimental telephone on this principle with very intense field it will be necessary to keep the damping of the diaphragm down as much as possible, and probably the diaphragm should not be made of iron. The moving iron part should be very light, and as small as is consistent with obtaining the advantage of the intense field.

Mr. R. W. Paul said that he had made a good many experiments in an effort to establish a method for tuning the diaphragm to various frequencies, and had had considerable success in using a screw which should be adjusted to act on different parts of the diaphragm and so modify its natural time period. Professor Irwin and the speaker had carried out a series of experiments by means of an ingenious device suggested by Professor Irwin, which consisted practically of a telephone receiver in the centre of which had been fixed a minute mirror. Using this device in connection with a beam of light and some reflecting device for the purpose of drawing out the reflected ray, one was able to study very carefully the movements of the diaphragm when the telephone was energised by various currents. The speaker would be quite willing to lend this apparatus to the Society if a member or members would be willing to come forward and carry out these experiments, which, the speaker felt sure, would be of very great use in investigating the problem as to the best receiver for wireless purposes. Referring to the remarks made by the previous speakers, he was not entirely in agreement on the question of the use of very intense magnetic fields, as his extended experiments as a manufacturer of moving coil instruments had shown that, notwithstanding theoretical considerations, very often when the magnetic intensity was pushed beyond a certain point, considerable troubles were experienced in eddy currents and stray fields which resulted in a loss of sensitiveness, and it was, therefore, an indisputable fact that it was not worth while going beyond a certain degree of magnetism.

Mr. H. H. Harrison remarked that it was an interesting fact that the condenser telephone of Ort and Rieger required a polarising voltage just as the magnetic telephone depended for its efficiency on a polarised field due to the received current. If the permanent magnet is suppressed, the telephone diaphragm vibrates at double frequency. He was inclined to think that the telephone of the future would be of the Penkert type, in which the vibration of the iron molecules gives rise to the sounds to be heard. It by no means followed that the telephone suitable for long distance communications between high power stations, where power, note and other conditions were fixed, and remained so, would also be the best for ship to ship work, and a lot of experimental work had yet to be done. The ordinary telephone had marked resonance points, and different, in this respect, from the human ear drum, which received all frequencies indifferently. This might furnish a hint to the designer. The present shape was dictated solely by convenience in machining operations and the requirements of press tools, and the fact that from the centre of area of the human tympanum no two radii were equal might have some bearing. Also it was evident that there was considerable difference in the damping between the natural and the artificial ear.

Mr. L. F. Fogarty thought that some more scientific method than the one usually adopted was necessary in connection with the measurement of telephone sensitiveness, and he thought that this meeting would be an excellent opportunity to obtain the opinion of various members on this point. At the present moment the telephones were usually classified according to their ohmic resistance and the reputation of the maker, but he ventured to think that some more scientific method could be adopted, and that it would be an excellent thing for the Society to be in possession of some device or method for carrying out such tests. Many of the previous speakers had emphasised the need of diaphragms whose movements were practically undamped, but he thought this point could be carried too far. No actual figures relating to the damping had been given, and therefore one had to consider the term "undamped" in a relative sense only, as a perfectly undamped diaphragm would be useless for wireless purposes, as it would probably only resonate to a definite frequency, and then would, by virtue of its presistent oscillation, prevent any differentiation between the dots and the dashes of the same note.

Mr. L. Turner said that he had made experiments with receivers with round pole ends, and had concentrated the field by turning down the pole tips, with very good results. He suggested winding coils on tiny wooden frames, which are a sliding fit over the pole ends. It is quite easy to wind a dozen such formers to various resistances so that they are easily interchangeable in two or three minutes. Thus, one might have a receiver wound to, say, 100 ohms easily interchangeable to 2,000 ohms if necessary. Where one has to contend with temperature variations he thought it advisable to fit a microscope adjustment for the air gap.

(Continued on page 58)

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HOW-TO-MAKE-IT DEPARTMENT

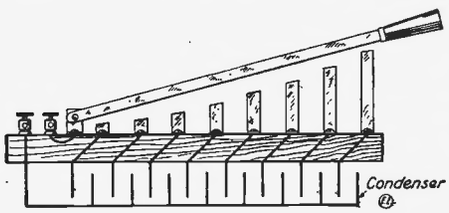
This Department will award the following monthly prizes: FIRST PRIZE $5.00; SECOND PRIZE $2.00; THIRD PRIZE $1.00. The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical, and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted, a prize of $5.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

FIRST PRIZE, $5.00.

A VARIABLE CONDENSER FOR RECEIVING AND SENDING.

By Irving Byrnes.

THE following is a description of the construction of a variable condenser for receiving which may also be modified for sending purposes if desired. The case should be made first out of any wood which can be finished smoothly. The dimensions are ten inches long, three inches wide and three inches deep. A cover for this case is required, the use of which will be described later. For the condenser proper, cut some tinfoil two by three inches, with a projecting lug one inch long; 15 sheets are required. Next split up 16 thin sheets of mica as a dielectric. These should be about 2½ by 3½ inches. Build up the condenser with the lug on the tinfoil leaves on alternate sides in the usual manner. All the lugs should be connected together on one side of the condenser but a separate lead should be brought out from each lug on the other side. Place the condenser in the box and fill it with paraffine wax. Procure a copper bar 10 inches long and ½ inch wide, by about 1/16 inch thick. Also make some clips from phosphor bronze strip. Eight will be needed, the first to be 1½ inches high, and each succeeding one a little shorter. An "Electrite" handle may be placed on the end of the blade. Then mount the switch blade, clips, and two binding posts on the cover of the case and fasten the cover on, connecting up as shown.



For sending, a larger box is required, and instead of mica glass plates, 8x10 inches covered on both sides with tinfoil leaves 6x8 inches, are very well used. Make the insulation as perfect as possible. With a sending condenser of the kind described the capacity may be quickly varied. All the materials may be purchased of the Electro Importing Company at a nominal price.

SECOND PRIZE, $2.00.

A PEROXIDE OF LEAD DETECTOR.

A very good peroxide of lead detector can readily be made from any crystal detector, having a spring adjustment, as follows:

Rivet or solder a spiral of fine platinum wire onto the spring, as in Fig. 1; and place a piece of thin sheet lead, ½" square, on the crystal cup, for the other electrode.

To make the peroxide of lead pellet, procure 1 oz. bleaching powder (Ca Cl_2 O_2, "Hypochlorite of Lime"), and about 3 oz. lead acetate; $(C_2H_3O_2)_2Pb$ solution.

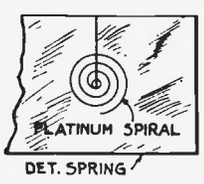


FIG. 1

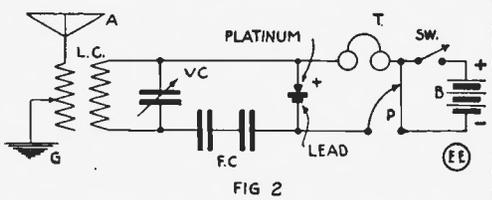


FIG 2

Make the solution of bleaching powder in distilled water, and add the lead acetate.

A precipitate of peroxide of lead is found which can be filtered from the solution, and partially dried with filter paper. To mould pellet, place partially dried mass of peroxide of lead in a piece of a glass tube about ¾" in inside diameter. When dry, pellet can be handled without fear of damaging it. Also the peroxide of lead pellet may be bought at the E. I. Co., at 20 cents net.

In connecting the detector, run the positive pole of the battery to platinum electrode; also use a potentiometer to secure best results, as indicated in diagram, Fig. 2.

—Contributed by James L. Green.

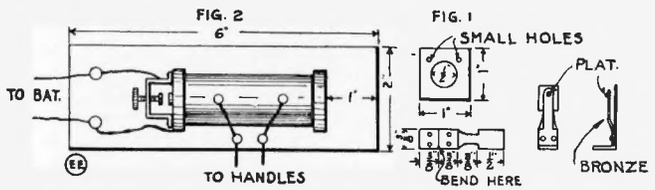
THIRD PRIZE, $1.00.

HOW TO BUILD A SHOCKING COIL.

The core of this induction coil is 3" long by ½" in diameter, and is composed of No. 20 or 22 Iron stove pipe wire.

The coil heads are made of ⅜" wood and are 1" square, a hole ½" in diameter being drilled in the center and two smaller ones as indicated in Fig. 1, for the lead wires to come thru.

The core should project ¼" from one of the coil heads. The core is covered with two layers of paper, then put one



end of No. 24 insulated wire through one of the small holes in the end cheek, and wind on 6 layers; passing the other end thru the second hole in the cheek. Be sure to wind it on smooth.

Cover the primary with 3 to 4 layers of paper and wind on 8 layers of No. 30 B & S gauge insulated copper wire, bringing out the two leads from same as usual.

A base board can be fixed up now and drilled as shown in Fig. 2. The coil can be covered to suit the builder.

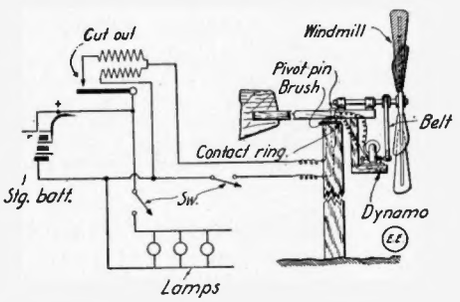
The vibrator can be made out of tin, brass and phosphor bronze as shown in Fig. 3; or it can be purchased very reasonably from the E. I. Co.

The connections are as follows: One wire from binding-post to one wire of the primary, and the other lead goes from the second binding-post to the vibrator bridge. The remaining wire of the primary goes to the vibrating hammer. The handles are joined to the secondary or fine wire terminals.

—Contributed by Otto Keppler.

WINDMILL DRIVING A DYNAMO.

Our illustration presented herewith depicts a windmill, such as those used for pumping purposes in the country, adapted to charging a storage battery from a dynamo belted to it. It is not practical to light lamps directly from the dynamo, as the speed of same would fluctuate widely, thus giving rise to flickering lamps; and on extra high speed the lamps would most probably be burned out. To overcome this state of affairs, a storage battery is floated across the dynamo mains, together with a suitable automatic cut-out, as supplied by the E. I. Co. in series, as we show in our sketch.



The lights may be used at any time and the dynamo is always charging the battery, whenever its speed is above a certain point, say 1500 to 1600 R. P. M. It is readily geared up to the shaft of the windmill so as to have the proper speed. The battery is, in this case, to be cut off from the dynamo, when it has received full charge; about 2.2 volts per cell on closed circuit, or 1250° Sp. Gr. density in the electrolyte, providing the discharge density value reached about 1150° to 1160° Sp. Gr.

TO BEAT THE EIFFEL TOWER.

The members of the International Wireless Telegraphy Commission met recently in the Royal Laeken Park in Brussels and placed the first rivet in a huge pylon to be erected there. It will be the largest in the world.

The tower, which is intended for scientific investigations of all kinds, more particularly in meteorology and wireless telegraphy, will be 1,092 feet high, or 100 feet higher than the Eiffel Tower.

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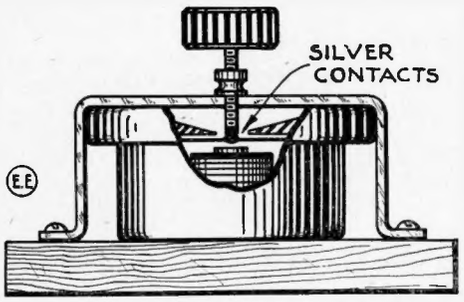
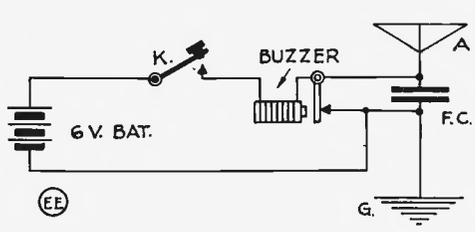
A HIGH FREQUENCY SENDING BUZZER.

AMATEURS now are beginning to use buzzers for short distance transmission and are doing very good work with them. A special buzzer is, of course, necessary and how to make one that gives a piercing note at a minimum cost is the object of this short essay.



Purchase an E. I. Co. pony receiver No. 1,024, remove hook and rewind bobbin with No. 24 enameled wire which may also be obtained from them. Bore a hole in the centre of the diaphragm and rivet in a piece of silver wire. Connect one wire from the bobbin inside the case to the diaphragm and lead the other wire out through the side. Screw the cap on to receiver tightly.

Obtain a wood base of suitable size, and a piece of 1-16 in. brass, ½ in. wide; bend it as shown and drill the necessary holes. Over the one in the centre, solder an 8-32 knurled battery nut for contact screw to run through. A No. 6,011 thumb screw with short piece of silver wire soldered to the tip is ideal for this.



Assemble whole and mount on the base and wire up as shown with an Electro fixed condenser No. 10,000.

By adjusting capacity of condenser and turning thumb screw a high pitch note will be emitted that will carry a surprising distance. The condenser prevents excessive sparking and the silver contacts will last a long time. This will work perfectly on 4 dry cells and is great for small portable sets.

Contributed by THOS. W. BENSON.

JACK BINNS, WIRELESS HERO, IS MARRIED.

Jack Binns, whose heroism as wireless operator aboard the White Star liner Republic, when that ship was wrecked, made him famous, married Miss Alice A. MacNiff at the home of the bride's brother-in-law, Fred A. Wernig, 1722 Caton Ave., Flatbush.

PANAMA RADIO PLANT.

The United States government is erecting three 600-foot towers near the Gatun locks, Canal Zone, Isthmus of Panama, which will be used to support the antennae of the Panama wireless telegraph station. The towers will be of triangular section, measuring 150 feet at the base and tapering to 10 feet at the top. The three towers will require about 1,000 tons of steel.

THE MARCONI FOG-GUN A MARVEL.

Guglielmo Marconi has added two new important improvements to his wireless invention. These are gun-firing by wireless and his new Marconi system of fog-signalling.

It is known that the Marconi experts have for some time past been testing an apparatus for distant control.

One thing has led to another. The distant control machine was combined with an automatic fog-gun, called the Stevenson-Moyes acetylene gun.

The latter was left on an isolated elevation in mid-ocean, where it had been erected and had been left unattended for weeks at a time in all kinds of wind and weather. It was thereby subjected to the "jamming" from the wireless signals received from ships passing nearby.

These tests have, however, proved satisfactory, as whenever the coast-guard had a transmitting apparatus set up, the gun was fired at intervals of about twenty seconds, giving both a loud report and a brilliant flash.

The gun contains a sufficient supply of actylene gas to allow for continuous firing, at the rate of three flashes and reports per minute, for from two to three weeks.

This transmitting apparatus which has been operated by the coastguards consists of a simple switch with "on" and "off" positions.

WIRELESS RECEIVERS.

(Continued from page 56)

The President (Mr. A. A. Campbell Swinton) pointed out that telephone receivers used for wireless telegraphy might differ largely from those employed in ordinary telephony, and that methods could be adopted for increasing the sensitiveness of the former that would be inadmissible in the case of the latter. This was for the reason that in telephony it was not sufficient that sounds should be emitted by the receivers, but it was also essential that these sounds should be articulate; whereas, in the case of wireless telegraphy, as long as short and long sounds corresponding to the signals of the Morse alphabet were emitted, it did not signify what was the character of these sounds. In receivers for wireless telegraphy the chief desideratum was to get audible sounds from the very weakest incoming electric currents. Professor Alexander Graham Bell, the inventor of the telephone, had told the speaker some years ago that in the earlier days of telephony he made innumerable experiments on diaphragms of different diameters and thicknesses, but he found that, within limits, provided you get a more or less constant ratio between the diameter and the thickness, it did not much matter whether you had a thick diaphragm of a large diameter or a thin diaphram of smaller diameter. In any given diameter of diaphragm a thick diaphragm is more articulate than a thin one, but the thin diaphragm is the most sensitive. It is no doubt for this reason that the diaphragm in telephones specially made for use as wireless receivers are considerably thinner than those used in ordinary telephony although the diameter is about the same. Another point of great importance, not, perhaps, as generally appreciated as it ought to be, probably for the reason that it is not obvious at first sight, is the fact that, in order to get maximum sensitiveness in a telephone receiver, the permanent magnetic field should be as strong as possible. This is for the reason —which becomes apparent when the matter is investigated mathematically—that the strength of the permanent field enters into the equation which determines the differences of attractive pull, and, consequently, the mechanical movements of the diaphragm, due to the action of at a speed greater than that at which the back the incoming electrical currents in varying the strength of the magnetic field. To get the utmost sensibility, it is, therefore, desirable to have as strong a magnetic field as possible.

Mr. Lucas, in reply, stated that he had tried the over exciter suggested by Mr. Blake, also using thickened centres, and he did not find much difference in practice. He thought that the suggested heavy telephone, weighing about 20 or 30 lb, and connected by indiarubber tubes to the ear, as in the case of the Grant telephone, was not advisable, as the loss in transmission by the tube would, no doubt, be larger than the advantage gained in sensitiveness by having an intense field. He further agreed with Mr. Paul that too intense magnetic field involved losses, and was not altogether desirable.

In answer to Mr. Fogarty, he stated that an excellent test for sensitiveness was trying to hear a very weak station, and that, in his opinion, a more scientific test would not be better unless the personal element could be eliminated.

PROF. FESSENDEN'S NEW HYDRO-TELEGRAPH.

News of the most recent triumph in submarine signaling was brought to our notice recently regarding test signals of the collier Devereux, as the latter was rounding Cape Cod, which were picked up by the tug Neponset, by means of the new apparatus invented by Prof. Reginald A. Fessenden.

On board the Neponset were Prof. Fessenden and a group of newspapermen, all of whom were able to hear distinctly the dry, unmistakable tone of the Devereux signal, carried under water all the way across Massachusetts Bay. It was even possible to determine the direction of the collier, her approximate distance, and to read the Morse signal by which she identified herself.

It was exactly 9:32 p. m. in the evening when Prof. Fessenden first picked up the signals of the Devereux. The first signal caught was "M S," in Morse code. By prearrangement the Devereux first sounded her port oscillator, with the letters "M S," over and over for five minutes. She then switched to the starboard oscillator, sounding "G O." After a five-minute interval of silence the same process was repeated, the collier keeping it up all the way across the bay. Just as her lights became visible to those on board the tug, the sound grew so pronounced that, even though the vessel herself could not yet be seen, the signals could be heard coming out of the water by the men on the tug's deck. That they were conveyed by the water and not through the air was proved by going down into the tug's forepeak, where they seemed much louder than on the deck. This will be of great service to marine interests.

The Borneo Islands boast a telegraph line constructed of mahogany and ebony poles. This is no doubt the most valuable telegraph line in existence.

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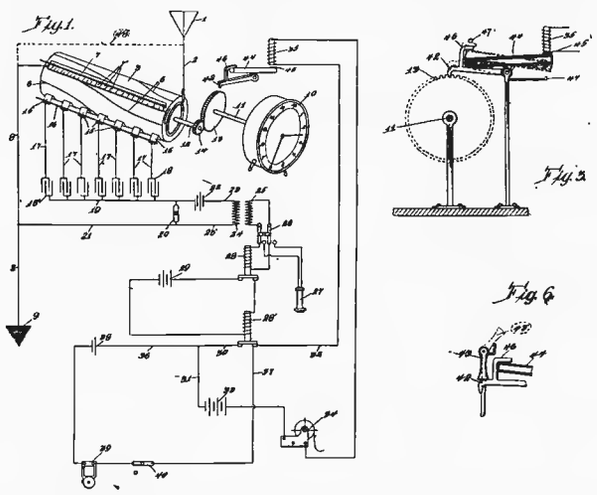
LATEST PATENTS

AN AUTOMATIC RADIO TUNING DEVICE.

Considerable attention has been given automatic radio tuners in the past few years, and one of the newest devices of this ilk, is described by its inventor, Earl G. Stalnaker, as follows, under his patent No. 1,099,865:

In the drawings, 2 in a conductor connecting the aerial antennae 1 with one end of an inductive coil 3, the latter consisting preferably of a single layer of insulated wire 4 wound upon a core 5 of hard rubber. The inductance coil 3 has its insulation scraped off the successive turns along spiral lines 6, thus exposing these bare points to a contact brush 7, which preferably has split fingers 7'. The number of spiral contact lines 6 on the coil may be as many as desired, provided that the pitch of the spiral allows one end of the brush 7 to contact with one spiral just before the other end of the brush leaves the preceding spiral. The brush 7 is connected by a wire 8 to a ground 9.

10 is a driving mechanism, preferably a clock or slow-speed electric motor, having a shaft 11 connected to the shaft 12



of the coil by gears, 13, 14, so as to rapidly rotate the inductance coil 3.

15 are brushes mounted on an insulated holder 16 and contacting with the surface of the inductance coil at an angle with the brush 7. Each of the brushes 15 is connected by a wire 17 to one layer 18 of a static condenser, whose other terminals 18' are jointly connected to a conductor 19.

20 is a wave-responsive element, such as a detector or coherer, inserted between the conductor 19 and another wire 21 leading to the ground wire 8.

22 is a battery connecting the wave-responsive element 20 (which is preferably an electrolytic detector) through conductors 23 and 23' to the primary 24 of a transformer having a secondary winding 25. 26 is a double-pole switch connecting this secondary coil with either a telephone receiver 27 or a sensitive relay 28.

29 is a battery connecting the terminals of the relay 28 with a more powerful relay 28', whose terminals are connected by wires 30, 31 and 32 with a battery 33, a recording "ticker" 34 and a stop magnet; also by wires 36 and 37 with a battery 38 and an electric bell 39.

40 is a switch for opening the bell circuit.

In operation, the clock 10 rotates the coil 3 continuously, thereby passing the spirally disposed contact points 6 under the contact brush 7 so as to vary the number of turns of the inductance coil 3 connected between the antennae 1 and the ground. Likewise, the brushes 15 will vary the number of sections of the condenser 18 connected between the aerial and the receiving circuit. Consequently, the receiving conductor system will continually be varied both as to its inductance and as to its static capacity, thereby making it correspond successively to oscillations differing widely in their periodicity or wave-length. If the tuning coil 3 is thus rapidly rotated in the presence of a wireless impulse, the wave-responsive element 20 will respond to the said impulse when the tuning coil is in the position where the brushes 7 and 15 make the receiving circuit 1, 2, 4, 15, 17, 18, 19, 20, 21, 8 responsive to the oscillations of the said impulse. The detector 20 will then close this circuit momentarily and in doing so will also momentarily close the circuit of the battery 22 thru the primary 24 of the transformer. Then the induced secondary current will actuate the relay 28, which in turn will allow the battery 29 to actuate relay 28', thereby closing the circuit of the alarm bell 39 which will call the operator. Relay 28' will also close the circuit of the magnet 35, which will attract a pivoted armature 45, thereby forcing a detent 42 between teeth of the gear 13, which detent stops the coil 3 and holds the brushes 7 and 15 in the position in which the receiving circuit is substantially attuned to, or in syntonism with, the receivable oscillations.

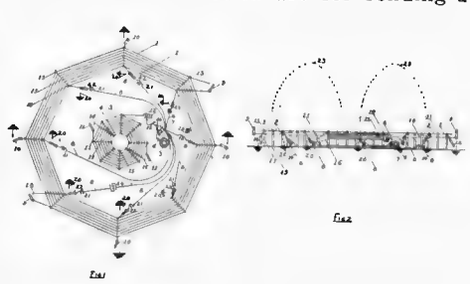
In practice, the impulse actuating the detector (and thereby locking the tuning system) may be of quite short duration and upon cessation of the impulse, the magnet 35 would release its armature, thereby allowing the tune-varying coil to rotate again. To avoid this I provide a pawl or catch 43 (Fig. 6) which is engaged by the detent 42 and holds this in the latching position until released by the operator. When the detent is thus held down, the receiving circuit is kept substantially in syntonism with the wireless wave which actuates the detector, so that successive impulses may be received by the receiver 27 or recorded by the ticker 34. When the message has been received in its entirety, the operator releases the detent 42 by moving the catch 43 to the position 43', thereby causing the tune-varier to resume its continuous changing of the inductive and electrostatic condition of the oscillation-receiving circuit.

At night time, it may not be desirable to arouse the operator, hence I preferably provide a self-timing release for the detent 42, as shown in Fig. 3, in which 44 is a hollow tube (preferably of brass) having a soft-iron armature 45 at the end nearest to the magnet 35. This tube is partially filled with a sticky or slowly flowing liquid which will be sluggish in flowing back from one end of the tube to the other. When the magnet tilts the tube, the sudden motion will start the liquid into the end of the tube which engages the detent, where the liquid will almost balance the armature at the other end of the tube. On cessation of the current thru the magnet, the tube or actuating member will tilt to the position shown in the dotted lines in Fig. 3; in this position it will engage the hook 46 on the detent and will tend to raise the latter, but the greater weight of the armature end of the tube will still be overbalanced by the weight of the detent. However, the liquid in the tube will now flow slowly down into the armature end of the tube until this outweighs the other end and moves the detent up against a stop 47.

While several unique arrangements of this apparatus have been worked out by Mr. Stalnaker, we have our doubts as to its practical adaptability under commercial conditions, for which the device is undoubtedly intended. Firstly, if a coherer is used as a detector at 20, fig. 1, then its regular operation is always doubtful, unless the tuning coil, etc., are revolved quite slowly. However, with the new and extremely sensitive relays now available and used in conjunction with a crystal or preferably an electrolytic detector of the "Electro" Radioson type, the whole arrangement comes within the sphere of workable possibilities. It may be of interest to our readers to know that such devices as this have been favorably passed upon before the Institute of Radio Engineers, of New York.

A NEW LOW ALTITUDE ANTENNA.

A new method of arranging a radiotelegraphic aerial is brought out in U. S. Patent No. 1,101,915 granted to Prof. Reginald A. Fessenden, the American Wireless savant. As seen from our sketches reproduced here, he employs two spirals of metallic wire or galvanized iron ribbon, as the patent specifies as preferable, and the two distinct spirals 1-2, and 3-4, can be connected by suitable switches to an A. C. radio frequency dynamo 5, or to a radio receiving set 27, alternately as desired. By means of the switches provided, any turns of wire in the antennae not in use for sending a certain signal, can be grounded; to prevent the setting up of closed loops of force within the active electro-magnetic field in use at any particular moment. More or less capacity is had in each antenna by connecting in more or less turns of the two spirals as desired. Loading condensers and inductances 24 and 21, etcetera, are arranged for, so that any wave length desired can be obtained.



It is understood that the axis of these two spirals are perpendicular to the earth, and may be placed only a small dis-

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tance above it, as 20 to 25 feet; and thus, this style of antennae is held to be of distinct value; specially as regards the initial cost of erection, which is very great for tall vertical aerials, having such altitudes as 400 to 800 feet.

A certain and large proportion of the electrostatic lines, instead of being projected up into the air as shown at 23, would normally be shunted direct to ground, and their energy wasted. This objectionable effect is overcome in two ways. First by placing horizontal circles of thin sheet iron 13 between the capacity 3, 4 and ground. These circles of sheet iron by their self induction tend to choke back and prevent the electromagnetic lines from going from the capacity 3, 4 to ground and from ground up again to the capacity 1, 2. Such loops of thin sheet iron may also be placed at 2, and as shown in cross-section at 14 and 14', and for a similar purpose, *i. e.* so as to choke back the electrostatic line from the capacity 1, 2 or from the ground 20. An alternative way which may also be used in conjunction with the above described way is to place a wave-chute 19 on the ground as shown, and to make this wave-chute of very low ohmic resistance so that part of the charge which is shunted from the capacity 3, 4 to the wave-chute, and thence along the wave-chute and up to the capacity 1, 2 instead of being projected up into the air as shown at 23, should have a very low resistance path to travel, and hence may oscillate backward and forward without wasting any energy, and having a natural period as little pronounced as possible.

By means of this invention Prof. Fessenden is enabled to do away with high masts and expensive antennae and to accomplish other useful purposes such as increasing the efficiency.

THE BORON DETECTOR.

Under the title of an "ethereal wave responsive device," Ezechiel Weintraub, of Lynn, Mass., has been granted U. S. Letters Patent, No. 1,096,142 patent on a radio detector employing strictly pure boron, the formation of which substance is covered somewhat at length in the patent. According to the claims made in this patent, phenomenal results should be obtained indeed with it. The detector acts on the thermo-electric principle, i. e. the incoming etheric wave currents passing thru it, cause the boron to beat up and it then changes its resistance, etc. We quote here from this interesting patent:

My present invention comprises an improved means for detecting and indicating ethereal vibrations, such as those used in the art of wireless signalling, or in bolometric measurements and determination.

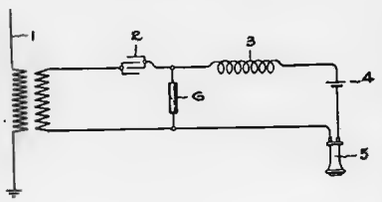

Fig. 1.

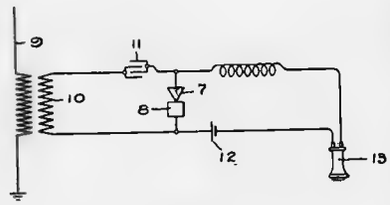

Fig. 2.

Of the wave-detecting devices used for wireless telegraphy and telephony, some are based on the changes of resistance indicated by a conductor when heated by the high frequency waves received from the antenna of the station. Others owe their wave detecting power to a change in the electrical action of a loose contact between two dissimilar conductive elements. In some cases advantage is taken of the rectifying action and the generation of a thermal electromotive force at the junction between suitable materials.

My present invention embraces an improvement in the various types of wave-detecting instruments above mentioned, by the use of boron or a boron alloy for at least one of the wave-responding elements of the device.

In the accompanying drawing, Figure 1 indicates diagrammatically a system of connections in which a boron conductor gives indications in a telephone because of its change in resistance when heated by energy received over the antennae; Fig. 2 is a similar diagram, showing a receiver based primarily on the use of a limited contact between the two active elements.

Many of the standard text books refer to the production of magnesium borid by reduction of boric anhydrid with magnesium, but prior to my own work in this field, Moissan is the only experimenter of recognized reputation who even claims to have produced pure boron. Moissan sought to prevent the retention of magnesium in the final product by using an excess of the boric anhydrid. He described the product as analyzing 93 to 95 per cent. boron, and as being a brownish powder, practically non-conductive for electricity and vaporizable without fusion. I am convinced that this material was not relatively pure boron, as Moissan supposed, but was in fact a boron suboxid associated with more or less magnesium borid.

I have discovered that elemental boron possesses properties which are altogether different from those possessed by the so-called boron referred to above. Pure or elemental boron can be fused into a dense body, which is black in color and has a conchoidal fracture. It is a fair conductor of electricity, and has a negative temperature resistance co-efficient of a magnitude without precedent among the chemical elements. I have found that at ordinary room temperatures the conductivity of pure boron doubles approximately for 17 degrees increase of temperature. In changing from room temperature to 400 degrees C., it changes according to the ratio of about one to two million. I have also found that the action of boron as a thermo-electric generating element is relatively strong.

For a full disclosure of my invention, I will first describe some methods for making pure fused boron. According to one process, boron chlorid is reduced with hydrogen in a high voltage alternating current arc maintained between water-cooled copper electrodes, as fully disclosed by me in my Patent No. 1,046,043. During the process of manufacture some of the reduced boron fuses on the ends of the electrodes and grows into beads or rods. Boron in this form can be applied directly to wave-detecting instruments. Some of the reduced boron, however, is thrown out by the arc as a powder on the walls of the arc chamber. This powder is compressed into a stick, and is then fused in a high potential arc operating in hydrogen, using the stick of boron as an electrode. The process and apparatus for carrying out this fusion by means of the high potential arc are fully described by me in my Patent No. 1,019,392. The fused product is used in a wave-detecting instrument.

In Fig. 1, I have shown a grounded antenna 1 equipped with the usual local circuit, including a condenser 2, an inductance 3, a local battery 4, and a telephone or other indicating instrument 5 to all connected in series, as indicated in the drawing. In shunt with a part of this local circuit is a boron element 6, of suitably small cross section, and serving as a wave-responsive device for the local circuit. Energy received over the antenna 1 will be transferred to the boron conductor 6, and there converted into heat, which will so change the conductivity of the boron as to vary the current applied to receiver 5 by the local battery 4. For this purpose a boron element possesses the very important requisites of high initial resistance combined with an enormous temperature resistance coefficient. The battery 4 should be of such low voltage that the boron element will radiate heat with sufficient rapidity so as not to run away, but will resume its high resistance as soon as the high potential oscillations have passed. In some cases the battery 4 can be entirely dispensed with, the energy for operating the indicating instrument 5 being part of the energy received by the antenna.

Altho I have shown the use of an antenna and other conductive elements for applying the vibratory energy to the boron element, it will be apparent that the energy might be initially in the form of light or heat when applied directly to the boron element, according to the general methods made public by Professor Langley and others in their many publications concerning the instrument known as a "bolometer."

It is thus seen that the boron element here acts similar to selenium, which changes its resistance with variation of light.

In Fig. 2, the boron element 7 makes but limited contact with the copper block 8. In this case, energy received over the antenna 9 will be transferred thru the inductive connection 10, and the usual condenser 11, and will pass thru the point of contact between the boron block 7 and the copper block 8, thereby locally heating the boron, and not only bringing into play the enormous negative temperature coefficient of the boron, but also establishing a thermoelectromotive force operative to increase the effect of the local battery 12 on the telephone or other indicator 13. It may be noted that for this purpose, copper and boron are specially adapted for use in contact, as the low chemical affinity of one for the other greatly lessens the danger of fusion at the point of contact.

In Fig. 3 the local battery is dispensed with, and the wave-detecting action of the boron element 4 is based on the generation of a thermo-electromotive force between the boron and the conductive element 15 of other suitable material with which it is in good contact. This electromotive force serves to establish the flow of current thru the path, including an inductance, and a galvanometer, or other suitable indicating instrument as 13.

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AMONG THE AMATEURS

WIRELESS COURSE FOR HIGH SCHOOL.

With the completion of the wireless telegraph set at the Chatham Academy of Savannah, Ga., a new course of study will be open to the High School boys.

The wireless plan was first instituted by Arthur Funk, and was eagerly taken up by some of the students. They have been working on the set about two months.

The installation has been declared by some as the best amateur production in the city. The aerial is over two hundred feet high, having a receiving radius of over two hundred miles and a sending radius, at present, of fifty or sixty miles. Both will be increased in time. The spark gap is of the rotary type, the latest in that line.

The new course will be optional, but there is no doubt that many will take advantage of it.

Yuan Lee of Holyoke, Mass., writes the E. I. Co.:

"Gentlemen:—I have one of your type 'SS' Dynamos connected with a 4" Water motor, and they give me sufficiently steady current to operate a bell, small motor and the ¼" Bull-Dog spark coil."

A. P. Rich of Birmingham, Ala., says in a recent letter to the "Electro" Company:

"Gentlemen:—Kindly attend to my present order at once, and as I already know the superiority of your goods over others, that is why I am sending you another order."

GIRL MOUNTS 425 FOOT RADIO MAST.

Miss Eva H. Reynolds, who lives with her father, Edwin Reynolds, on his estate near New Brunswick, N. J., rode through the air in the bo'sun's chair recently to the top of one of the 425-foot iron masts that support the aerial of the Marconi Company's wireless telegraph station, just completed near her home. Standing in the workmen's box at the top of the mast, Miss Reynolds named the station "Scio," breaking a champagne bottle over the point of the mast. Then she was lowered to the ground. She said she was not in the least nervous.

Wireless instruments for the Los Angeles National Guard station are being made at Polytechnic High School by Victor Wagner, who is a student of the school and a member of Battery A at Exposition Park. When the station is completed it will be strong enough to send messages all over the State and will be equal to any military equipment in California.

It is claimed for the instrument that messages have been heard from some of the Pacific liners while they were just off the Japan coast.

BOY SCOUTS USE WIRELESS.

The Boy Scout camp on the State reservation at Ponkapoag, Mass., is in readiness for a busy season. A new wireless set has been installed. The receiving set will respond to signals up to about 500 miles. The sending set will send five miles.

JEWELER'S RADIO SET AT LODI, CAL.

H. D. Sharp, the jeweler, has installed a wireless telegraph outfit of the latest model. By the aid of this machine he is enabled to get the time signals as they are flashed from the government observatory at Mare Island. By connecting with the electric light wires thru a condenser the whole system

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Jerry J. Manning of Ashtabula, Ohio, says of our magazine:

"I think your magazine *'The Electrical Experimenter'* is superb, and starting out in the right way. I enclose remittance for an extra copy of the February issue, and beg to remain, with best regards, etc."

E. I. Co., N. Y.

"I received order O. K. and everything in A1 shape. The Radioson Detector is a "Peach." I am using it alongside of a very sensitive Galena, and it is not only *louder* but *clearer* and *always in adjustment.* You may expect an order for more soon.

Yours truly, V. E. SMITH.

Mr. Chas. S. Lirely of Blocker, Ark., an E. I. Co. patron, writes as follows:

"Some time ago I sent the E. I. Co. my second order amounting to $22.00 and I wish to advise that I am well pleased and entirely satisfied with all the goods received. The 1-inch spark coil is much better than described; the static machine is certainly fine; and the Free Wireless Course is the *most valuable book I possess.*"

WIRELESS AT COMMENCEMENT.

The most novel feature ever included in a Long Island high school commencement programme was the wireless telegraph exhibition given from the stage of the Bayville Opera House at Sayville, on Wednesday by Walter Guldi and Carroll Livingston Homan, of the class of 1914.

Mr. Homan told of the process of sending wireless messages and Mr. Guldi had a chart showing the receiving apparatus, which he explained in detail. A complete receiving system had been installed on the platform, and the Boy Scouts had put up an aerial on the opera house flagpole. The young men intercepted a message to ocean liners being sent from the big tower of the Atlantic Communication Company at Sayville. By special permission they were permitted to give the text of the message to the audience.

The regular meeting of the Geneva Wireless Association of Aurora, Ill., was held recently at the home of George Esser, the president. Lyman McDill gave a talk on Marconi, the Great Inventor.

Mr. LeRoy West, an E. I. Co. patron, writes them:

"I received my phones the other day and they certainly work excellently. I have lately added to my set one of your Gernsback Rotary Condensers, which connected across the secondary of my loose coupler, gives excellent results.

"I can recommend your instruments to be in the **First Class** for the amateur."

Walter Barney of Arlington, Wash., writes in a recent letter:

"I received my E. I. Co. order No. 106205, and I am very glad to say that I am entirely pleased with your goods. Their No. 6666 Phones are very sensitive, and they stand the test you mention."

ELIZABETH, N. J., YOUNG MAN A COMMERCIAL OPERATOR.

Harry Hersh, son of Mr. and Mrs. Edward C. Hersh of 254 First avenue, Elizabeth, N. J., departed recently on the Steamship Allemannia of the Hamburg-American line as second wireless operator. The vessel sailed for Inagua, Cape Hayti, Port de Paix, Gonaives, Port au Prince, Jeremie, Aux Cayes, Cartagene and Puerto Colombia.

Mr. Hersh is an experienced wireless man, having made a close study of the science. He has a complete wireless outfit at his home, and receives messages daily from all parts of the country.

GODFREY ROCKEFELLER IS WIRELESS EXPERT.

Godfrey Rockefeller, second son of William G. Rockefeller, has been recognized by the Hartford Radio Club as being the most expert and best equipped wireless operator in that section of Connecticut, well fitted to be an active member of the State Relay Association now being formed for the purpose of proving useful in emergencies and offering itself as an adjunct to the state and national government in case of war.

Young Rockefeller, who is a nephew of John D., has a one kilowatt outfit.

He is a student in the Brunswick Boys school and has taken a great interest in electrical matters. He is said to have one of the best radio outfits in the state.

J. F. Ballard, Jr., writes the Electro people:

Beeville, Texas.

Messrs. Electro Importing Co.,
New York City.

Dear Sirs: I received the "INTERSTATE" Wireless Outfit some time ago, and up to now I have received from VICTORIA, about 58 miles. They have a very good outfit there. I made a fine aerial out of the 2 lbs. antenium wire and the 2 insulators and I have a very good station. The STATIC that I hear from the dynamos comes in very loud, but the dots and dashes scratch through it anyway. I am going to move to Hamiltonberg and then I will buy a sending outfit to talk with to one of my friends here. Thanking you very kindly,

J. F. BALLARD, JR.

WIRELESS STATION CONTEST

We will inaugurate in the next issue of the "Electrical Experimenter" a **Wireless Station Contest,** open to all readers, and a monthly prize of $3.00 will be offered for the best description and photo of a wireless or electrical laboratory. Be brief and send us dark toned prints in preference to light tones ones. Write your description on separate sheet of paper.

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QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. At least one of the questions must deal with "E. I. Co." apparatus or instruments, or "E. I. Co." merchandise.
2. Only three questions can be submitted to be answered.
3. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no pencilled matter considered.
4. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this Department cannot be answered by mail.

GENERAL RADIO QUERIES.

(145.) Mark Biser, Middletown, Md., asks a number of radio queries in a recent letter. We are pleased to advise him as follows:

A. 1. The new type E. I. Co. "Transcontinental" outfit is now made up with the "Radioson" Detector of the *battery-less type,* and also includes their No. 8487 loading coil for tuning in long wave lengths.

The No. 1886A large size tuning coil is furnished on same in place of the No. 12002 loose coupler and you will find it a very fine set indeed.

In regard to exciting a 200-foot length flat-top Antenna with a small spark coil such as the 1" "Bull-dog" size, would say that you may try this arrangement which has been utilized considerably by several of our patrons with wonderful success; and when such a large aerial is used with a small spark coil no other condenser or helix is used with same; the inherent capacity of the aerial being sufficient, as also its inherent inductance.

We believe your lightning switch made up as per your dimensions would be all right, but it is best to purchase these switches of approved pattern as required by the Fire Underwriter's rules, and as listed and described in the E. I. Co., new catalog No. 14. The Wireless Law is fully described in the "Treatise on Wireless Telegraphy" published in their catalog, and where a transmitting station cannot send over the State border line or interfere with the interchange of commercial or other bonafide radio messages between two states; no license is required for such stations. Receiving radio stations only, require no license at all. You may obtain full details regarding Radio Operators' Licenses, etc., by addressing the Radio Inspector, c/o Custom House, Baltimore, Md.

AERIAL CURRENT RELAY CORRECTION.

(146.) E. J. Sedlak, Union, N. J., writes us regarding an error which crept in possibly while translating the article in a recent issue, covering a radio relay of special type.

A. 1. Answering your esteemed favor we thank you for calling our attention to an error which occurred in publishing an article on "A New Wireless Relay," in the March Electrical Experimenter.

This probably occurred in translating the article from the French paper "T. S. F." and the amount of wire should be 10½ ounces for the 7,650 ohms, which corresponds to 300 grams, instead of the quantity there stated.

FREAK RADIO SIGNALS.

(147.) Cyril Baston, San Diego, Calif., says in a recent letter to this department:

Q. 1. How is it that I can hear the buzzer test current in my wireless head phones, even with the detector point off the crystals?

A. 1. We have experienced the same phenomenon that you have, viz.: that a buzz may be heard in the telephone receivers, even when the "Cat-Whisker" is removed from the detector crystal; but this buzz is usually caused by making a *ground* with the fingers on some metallic part of the circuit, in many cases; and is explained by the charging of the body; or also by the considerably high voltage charging set up in the circuit by the buzzer *make and break,* which is aided by the condensers in the circuits, charging and discharging, etc.

DYNAMO WINDINGS.

(148.) Cyril H. Warren, Escondido, Calif., writes:

Q. 1. He asks several questions relative to a 4 pole D. C. dynamo he is building, etc.

A. 1. We have no data on hand regarding the machine you speak of but can supply a very good book at $2.25 prepaid, by C. P. Poole, entitled "Small Motor and Dynamo Designs," which covers such machines as the one you are interested in.

Suffice it to say that if the field magnet is to have 4 poles and only two brushes are to be used on the armature commutator, that a wave winding must be used on the armature; or if a common lap or series winding is utilized, the commutator will have to be cross-connected at diametrically opposite points by jumper connections run across the back of the commutator, all way around so that every opposite pair of bars are joined together.

Also we take pleasure in recommending a thorough and complete treatise on D. C. dynamo and motor design, including all necessary formulae, etc., by Wiener, at $3.20 prepaid.

SMALL COMBINED A. C. AND D. C. DYNAMO.

(149.) Walter E. Shiley, Lancaster, Pa., asks:

Q. 1. Can I procure an "Electro" No. 810 Dynamo fitted with 2 slip rings so that A. C. can be taken from it, as well as D. C. at the same time?

A. 1. They do not supply regularly any small dynamos such as the type "S S" or No. 810 machine fitted with slip rings allowing of taking A. C. from same, but you can readily have a couple of rings fitted on one of these machines at any local machine shop or probably you can do it yourself. The two rings are connected to diametrically opposite points on the commutator or on the armature winding for a two-pole field, and two brushes make contact with the rings, which deliver a single phase A. C. of about .7 that of the D. C. value.

STATIC MACHINE PLATES.

(150.) Wm. Rebnann, Buffalo, N. Y., writes us in a recent communication:

Q. 1. Does the E. I. Co., supply Static Machines Plates 20 inches in diameter?

A. 1. They quote a price of $1.50 each, net on special glass static machine plates without tin-foil sectors, with 1½" hole at the center for shaft, and 20" in diameter.

If you desire some of their patent "Electrite" plates which are very rugged, and also which generate electricity in practically any kind of weather, owing to the special material used in making same, the price for 20" diameter plates without tin foil sectors, will be $2.25 each.

SELENIUM.

(151.) Braun & Bryce, N. J., wish data on "Electro" selenium and cells made of same, electrically sensitive to light variations.

A. 1. Replying to your esteemed favor of recent date, would say that the only metallic element they handle is selenium, covering the electrical functions you mention, i.e.: having the function of changing its electrical resistance when exposed to light and dark, etc.

This material is quite brittle and extremely hard in the stick form, which they handle, at $1.50 per ounce or 50c for a liberal size piece which is the least quantity sold. The standard sticks measure about 5 to 6" long and are about ⅜" in diameter.

If you intend utilizing selenium in cell form for operation in regular circuits with a relay, etc., in the usual manner, you will probably do best to purchase one of their cells complete which are worth $5.00 apiece. There is no particular scarcity of selenium on the market, in so far as we are aware, although it is of course not cheap, by any means.

STORAGE BATTERY QUERIES.

(152.) A. L. Franklin, Chickasha, Okla., asks us several questions relative to a storage battery which he has made.

A. 1. In regard to the storage battery which you have made, would say that the plate make-up appears to be alright, but apparently you are using the wrong solution in same and this will properly be made up of 5 parts pure water and 1 part sulphuric acid by volume or as measured in a glass graduate, etc. This gives a specific gravity of about 1250 degrees, the common one for lead cells.

The usual charging rate for lead storage cells is the 8 hour one; and thus the ampere-hour capacity should be divided by eight, to give the number of amperes at which the battery should be charged.

ELECTRO-MEDICAL HAND-BOOKS.

(153.) Geo. Perkins, Astoria, Ore., writes us:

Q. 1. What books can you furnish on Electro-Medical practice of an understandable nature and not too technical?

A. 1. We take pleasure in recommending Dr. Strong's excellent Electro-Therapeutical hand book at $1.25, or if you wish a more pretentious work on the subject which is very complete and thoroughly up-to-date, covering both the electrical and therapeutical sides of the subject, we can supply an excellent treatise by Dr. Strong, also, at $3.20. The above E. I. Co., prices for books are prepaid prices.

RADIO STATION LOCATER.

(154.) William Galati, New York City, inquires of the Question department:

Q. 1. Is it possible at the present time to locate the source of a certain radio signal when the station's location is not known?

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A. 1. It is possible, as we understand it at the present time, for Radio Inspectors and those equipped with the necessary apparatus such as the Marconi-Bellini-Tosi radio-goniometer, to trace a wireless call quite accurately without knowing the exact location or whereabouts of the station originating such a call.

This apparatus has been covered in several of the wireless journals from time to time.

GORDON PRIMARY CELLS.

(155.) J. G. Fox, Ill., says in a recent letter:

Q. 1. State the length of time a Gordon 100 Ampere-hour primary cell will operate a tungsten battery lamp of given C. P.?

A. 1. Answering your query regarding batteries would say that the Gordon 100 A. H. Primary battery will operate a tungsten lamp or other apparatus the number of hours given, by dividing the ampere hour capacity, by the amperes consumed by such apparatus.

For instance: if a lamp requires 1 ampere of current such as a 10 volt 10 C. P. tungsten lamp, etc., the 100 A. H. battery will light this lamp approximately 100 hours. In general you should figure on a discharge rate from these primary cells of about 5 to 8% of the A. H. rating, which would be about 5 to 8 amps. for the 100 A. H. cell. These Gordon cells give of course .7 volts each when working; and hence a sufficient number of them must be connected in series to give the necessary voltage to operate the apparatus desired, such as a 10 volt lamp, etc. This is found by dividing the number of volts desired by .7 of course.

LOOSE-COUPLER WINDINGS.

(156.) Harold Sever, Pleasant Plains, Ill., asks:

Q. 1. Is it all right to use more than one layer of wire on the secondary and primary coils of a Wireless Receiving Transformer?

A. 1. It is the general standard practice in designing wireless receiving transformers to use but one layer of wire on the primary or secondary of same, but some of the best apparatus of this class such as the "Telefunken" instruments; are made up with two layers of wire on these windings, but every other turn is staggered back on top of the preceding turn so as to minimize distributed capacity as much as possible, as explained on page 10 of the May, 1914, "Electrical Experimenter."

Q. 2. State the sending range of the radio station at Radio, Va.?

A. 2. The Government Radio station at Radio, Va., has an approximate daylight sending range of 2500 to 2800 miles and it has been heard 3300 to 3500 miles at night; and sometimes more, under particularly good conditions.

Q. 3. Can the E. I. Co., supply a 1 K.W. alternator of 110 volts potential, 60 cycles frequency, and at what price?

A. 3. They can supply a 1 K.W. self-excited alternator complete with driving pulley, etc., of the 110 volt 60 cycle A. C. type at $84.00 net, F. O. B. New York, delivery about 15 working days after receipt of the order.

A. C. MOTOR PRICE.

(157). E. A. Strong, Winnipeg, Man., Canada, writes us:

Q. 1. Please quote E. I. Co., price on 1/20 H. P. 110 volt, 60 cycle A. C. motor; also on larger size A. C. motors for single phase circuits.

A. 1. We are pleased to give you herewith a price list of dynamos and motors suitable for your requirements and on a small size 1/20 H. P. 110 volt cycle A. C. 1750 R. P. M. induction motor of the squirrel cage type. The price is $15.50 net, f. o. b. New York.

"Electro" Alternating Current, Single Phase Motors.
Automatic Self-Starting Type.

Type	Volts	Cycles	Speed R.P.M.	H.P.	Net Pr. f.o.b. N.Y.
EM-1	115	60	5000 (Variable Sp'd)	1/15	$18.15
EM-2	115	60	1750	1/8	22.70
EM-3	110	60	1750	1/4	28.40
BE-1	110	60	1800	1/2	50.40
BE-2	110	60	1800	3/4	61.60
BE-3	110	60	1800	1	77.00
BE-4	110—220	60	1800	1-1/2	99.75
BE-5	110—220	60	1800	2	105.80

Types EM 1-2-3, furnished for 230 Volts 60 cycles at 10% advance on above prices. EM-1 type, has lever on Motor to change speed as desired.

Low Voltage Motors. (Special.)

Type	Volts D.C.	amp.	Speed R.P.M.	Net Wt. lb	f.o.b. N.Y.	H.P.	Winding
EC	6 or 8	37	1800	20	$25.20	1/6	Shunt or series
EB	6 or 8	22	1800	18	25.20	1/8	" " "
EA	6 or 8	12	1800	16	25.20	1/16	" " "

Above Motors fitted with pulley for flat or round belts. No starting box required.

Standard Voltage Motors.
Protected type.—Direct current.

Type	Volts	Speed R.P.M.	Net Wt.lb	Wind'g Shunt	H.P Output	Net Pr. f.o.b. N.Y.
E-1	115	1500	10	Shunt	1/24	$12.60
E-2	115	2000	10	Shunt	1/16	11.35
E-2A	230	2000	10	Shunt	1/16	13.52
E-3	115	2050	16	Shunt	1/10	15.12
E-3A	230	2050	16	Shunt	1/10	17.00
E-4	115	1900	20	Shunt	1/8	14.20
E-4A	230	1900	20	Shunt	1/8	15.75
E-5	115	2500	20	Shunt	1/6	14.50
E-5A	230	2500	20	Shunt	1/6	16.70
D-1	115	2400	22	Shunt	1/4	22.10
D-1A	230	2400	22	Shunt	1/4	23.80
D-2	115	2300	35	Shunt	1/2	42.70
D-2A	230	2300	35	Shunt	1/2	45.85
D-3	115	2250	57	Shunt	3/4	49.90
D-3A	230	2250	57	Shunt	3/4	53.70
E-4	115	1875	155	Shunt	1	58.60
E-4A	230	1875	155	Shunt	1	59.90

Prices on larger or special Machines on request.

Automatic No.- Voltage release starting boxes with all Motors above ¼ H.P.

VIBRATING RECTIFIERS.

(158.) A. S. Burleigh, Great Falls, Mont., writes the Question Department:

Q. 1. What D. C. voltage is delivered by the A. C. Vibrating Rectifier described in the May, 1914, "Electrical Experimenter," if used on 110 volt A. C. 60 cycle, single phase circuit.

A. 1. Depending upon the resistance used in series with the vibrating rectifier described in a recent number of the "Electrical Experimenter," the D. C. Voltage can be varied to suit requirements. This is usually from 80 to 90 volts, if a lamp bank made up of 110 volt lamps is used on the A. C. supply circuit.

MEDAL FOR MARCONI.

The Council of the Royal Society of Arts, of England, with the approval of its President, the Duke of Connaught, has awarded the Albert Medal for the current year to William Marconi "for services in the development and practical application of wireless telegraphy."

The medal was instituted in 1862. The first was given to Sir Rowland Hill. The King received it last year.

ROYAL
"THE TYPEWRITER OF TRIPLE SERVICE"
It Writes, Types Cards, and Bills!
THINK of the tremendous advantage of one machine for all of these various uses—one typewriter with the combined advantages of many—no attachments!
The stenographer can now turn instantly from the letter she is writing to "bill-and-charge," loose-leaf indexing, or the most complex card-typing, without stopping for a second, or changing to a "special" machine. The New Royal Master-Model 10 has every standardized improvement: Tabulator, Back-Space Key, Bi-Chrome Ribbon and Automatic Reverse, and many brand-new Royal Features.
ROYAL TYPEWRITER COMPANY Inc.
Royal Typewriter Building, Broadway, New York
Price $100
In Canada $125

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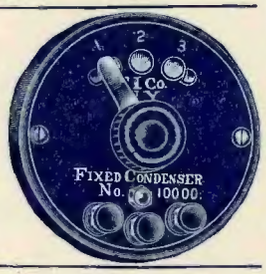
THE E. I. CO. NEWS

New 1914 No. 14

Second Edition Catalog Ready

Contains Lots of New Apparatus

The "Electro" Fixed Variable Condenser



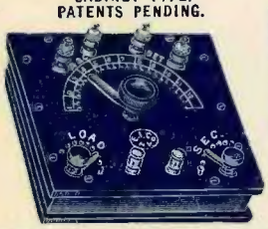
The case is of solid hard rubber composition, as is also the thumb screw, which latter is 1 in. in diameter. There are three binding posts. Switch lever and switch points are nickel polished; there are two stops to check the lever. Our illustration does the instrument but scant justice. It must be seen and worked to fully appreciate it.

Sizes are 4 in. x 1½ in. Shipping weight 1 lb.

No. 10000 "Electro" Fixed Variable Condenser $1.25

The Mignon Vario Selective Coupler

CABINET TYPE. PATENTS PENDING.

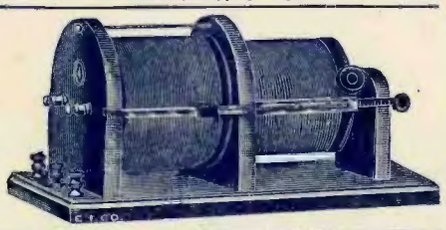


This is the smallest and most compact long distance wireless receiving outfit manufactured and we particularly recommend it FOR RECEIVING TIME SIGNALS as sent out by the various U. S. Government Wireless Stations. The outfit may be used with any type of detector and any phones, but we particularly recommend the use of the No. 9300 Radioson Detector and our No. 6666—3000 ohm Government phones.

No. 11000 Mignon Vario Selective Coupler (no phones or detector), shipping weight 5 lbs. $7.50

No. 11001 Mignon Vario Selective Coupler complete with No. 6666 Government 3000 ohm Phones and No. 9300 Radioson Detector, shipping weight 10 lbs. ..$19.50

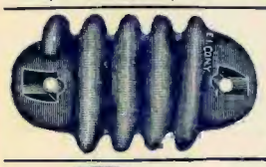
"Electro" Professional Loose Coupler



The "Electro" Professional Loose Coupler is guaranteed to do the work of any professional loose coupler, regardless of its price. Note size of this loose coupler, base 15½ x 7¼ x 7½ high.

No. 14000 Professional Loose Coupler $7.50

The "Electro" Junior Strain Insulator

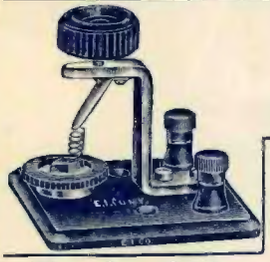


Size over all 2¾ in., diameter 1¼ in., net weight each 3½ oz.

No. 9461 "Electro" Junior Strain Insulator, shipping weight 3 lbs. per eight..... $0.10

The "Electro" Galena Detector

(WITH ROTARY DETECTOR CUP)



Size of Detector, 3½x3½ in.

No. 9700 Detector complete as described, shipping weight 1 lb. $1.25

The Gernsback "Push-Post"

No. B 75 Gernsback "Push-Post," Price ea. .$0.08 shipping weight 1 lb. per doz

Free Wireless Correspondence Course in Twenty Lessons by S. Gernsback, A. Lescarbourth, and H. W. Secor, E. & R. Eng., with every order. See catalog for information.

ELECTRO IMPORTING COMPANY,

236 Fulton Street, New York City.

Tear off here and mail to our address. If you wish our Detector send 10c. instead of 3c.

I enclose herewith 3c. in stamps for which please send me your new electric cyclopedia for 1914, number 14, 2nd edition, containing 400 illustrations and over 1600 articles and valuable information on Electricity and Wireless. Book also contains 20 free coupons for your 160 page wireless course in twenty lessons.

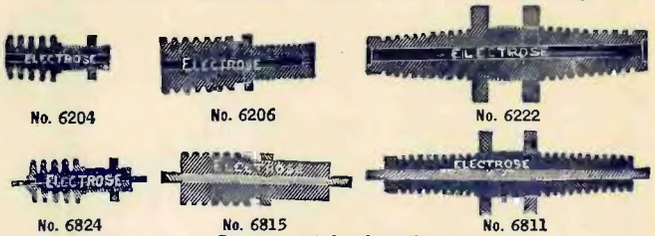
Name.....

Address.....

State.....

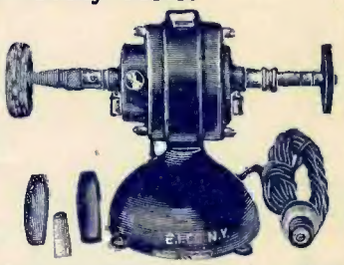
10¢
A REAL WIRELESS DETECTOR FOR 10 CENTS
We want to acquaint you with "Wireless." Read this astounding and hitherto unattempted offer. For 10c. we will mail you prepaid a complete wireless detector exactly as illustrated, size 2"x1½"x1¼", in connection with any telephone receiver and a wire on your roof. This detector is guaranteed to receive messages from 100 to 500 miles. Complete instructions furnished. This detector is no toy but does exactly the same work as a $10.00 instrument. If you have no receiver get our 75 ohm Pony telephone receiver for 50c. prepaid. Detector and Receiver 60c prepaid. Your money back if dissatisfied.
GALENA
NICKEL DETECTOR CUP AND BINDING POST
HARD RUBBER HANDLE
SOLID FIBRE BASE
NICKEL STANDARD AND BINDING POST
FREE with detector: A copy of our famous Electrical Cyclopedia No. 14, containing 400 illustrations, 1,600 articles, "Treatise on Wireless Telegraphy" and 20 coupons for free Wireless Course, also copy of Magazine "The Electrical Experimenter." If detector is not wanted send 3c. for other books.
Electro Importing Co. 236 Fulton St., N. Y. City
"Everything for the Experimenter"
10¢

"Electrose" Lead-in Insulators and Bushings



See new catalog for prices

The "Electro" Utility Motor



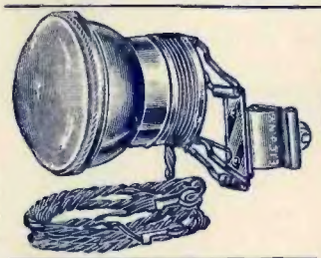
No. 325 "Electro" Utility Motor, complete outfit for 110 volts D. C.; shipping weight of complete outfit 12½ lbs.... $9.35

No. 326 "Electro" Utility Motor, complete outfit for 110 volts A. C. 60 Cycles; shipping weight of complete outfit 12½ lbs. $9.35

No. 315 "Electro" Utility Motor (motor only) with regular 1 in pulley on low base, for power purposes for 110 volts 60 Cycles A. C.; shipping weight 9½ lbbs..... $7.85

No. 316 "Electro" Utility Motor, same as No. 315, but for 110 volts D. C.; shipping weight 9½ lbs..... $7.85

The "Electro" Bicycle and Carriage Lamp



No. 6710 Electro Bicycle and Carriage Lamp, complete with leather battery case and battery; shipping weight complete 2 lbs. $2.25

No. 6711 Renewal Battery 4x1⅜x3¼ ins.; shipping weight 1 lb. $0.35

No. 4000 3½ Volt Renewal Lamp; shipping weight 4 oz..... $0.25

The "Electro" Bicycle and Coat Lamp

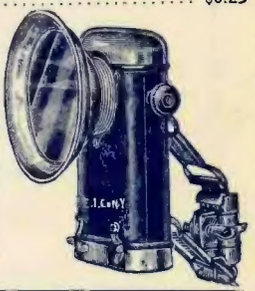
No. 6715 Electro Bicycle and Coat Lamp; shipping weight complete 2 lbs. $1.65

No. 1056 Renewal Battery; shipping weight 1 lb.... $0.20

No. 4000 Renewal Lamp, 3½ Volts; shipping weight 4 oz. $0.25

The "Electro" "Detectiphone"

For Aiding the Deaf. Radio Amplifiers and Detective Work.



No. 9750 "Detectiphone;" shipping weight 2 lbs. Price..... $14.00

No. 9751 Extra Batteries; shipping weight 1 lb. $0.30

No parts sold separately.

The "Electro" Type J Medical Battery

No. 6718 "Electro" Type J Medical Battery $6.25

Shipping weight 13 lbs.

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